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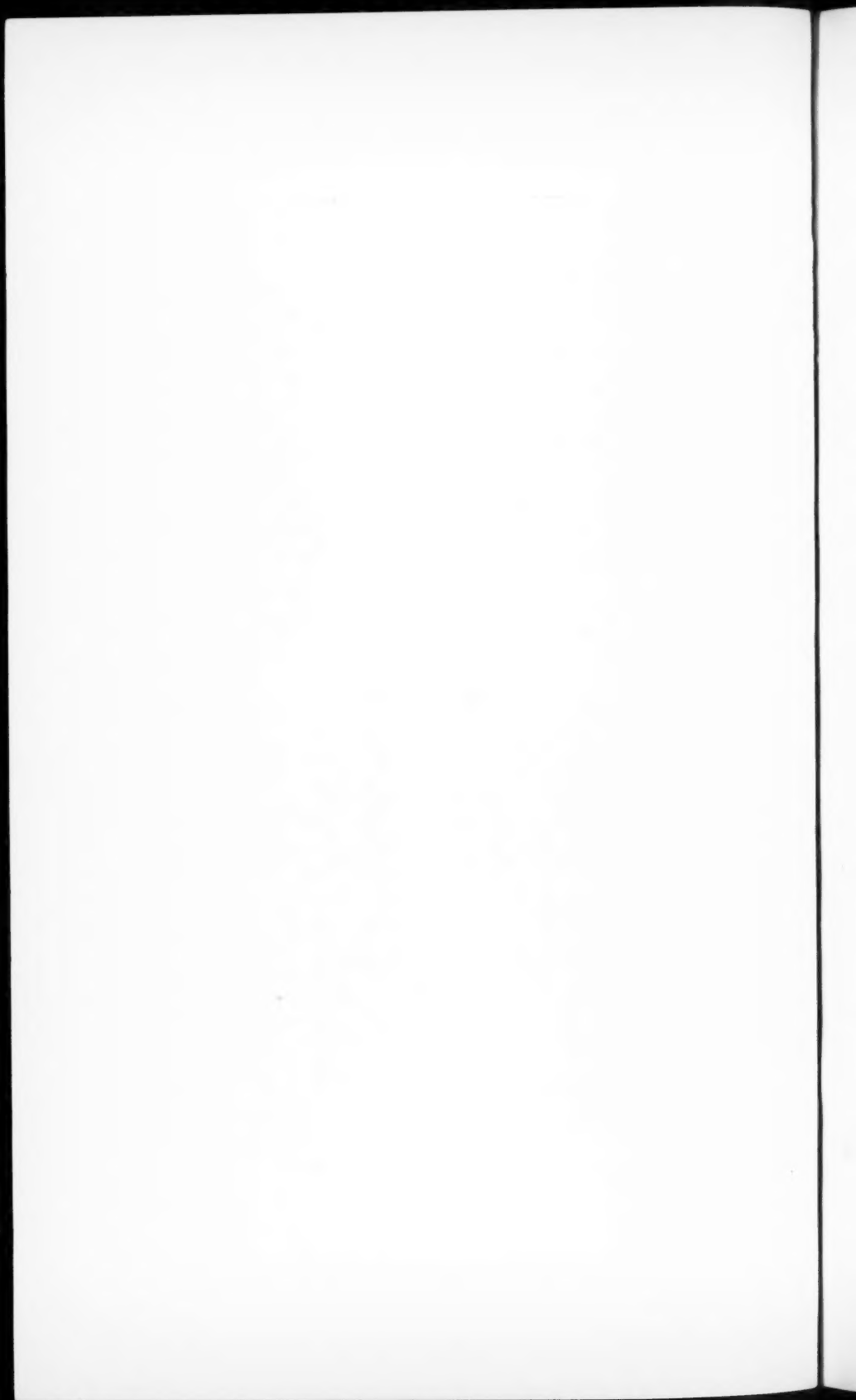
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HANAU WOLF LOEB

August 25, 1865—July 6, 1927

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ANNALS
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LI.

THEORIES OF SOUND ANALYSIS AND INTENSITY
CONTROL ON THE BASIS OF MIDDLE AND
INNER EAR MECHANICS.*

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ST. LOUIS.

It was my privilege, at the meeting of the Triological Society in St. Louis, to intimate the desirability of throwing overboard all existent ideas on sound transmission and sound analysis in so far as they are related to the problem of audition. It would then be possible to approach the subject with an open mind, unhampered by established precedents and traditions. Ignorance has never offered a serious obstacle to scientific advance. It is misinformation that lies entrenched behind a rampart of constant repetition which blocks the pathway toward progress. Vicarious immortality appears to be conferred upon any seemingly convincing statement once it is printed in a textbook, particularly if set off in quotation marks and attributed to some well known authority.

It would seem as if physiologist, psychologist, otologist and physicist have unwittingly conspired to shroud the problem

*Read before the Middle Section of the American Laryngological, Rhinological and Otolological Society, St. Louis, Jan. 31, 1927.

with mystery. Some maintain that even the anatomist has contributed his bit. The situation, after seventy-five years of active investigation, has resulted in a tremendously involved series of experiences, full of misunderstandings and obvious personal equations. The "proof of the pudding" may be found in the prevalent pessimism in a favorable prognosis for the deafened and in the failure to establish any sort of a constructive program for the prevention of otologic disabilities. As a result of this condition, deafened people are susceptible to any suggestions and so fall an easy prey to the charlatan. The situation is, therefore, an open challenge to the imagination, ingenuity and application of anyone interested in the problem of the deafened. Something more can be done, because something more must be done!

Two facts stand out prominently in a general review of the subject. In the first place, the normal mechanics and the basic physiology of audition will never be determined through the investigation of dead ears. Secondly, in place of any haphazard technic, the available system must be thoroughly studied with quantitative methods under test conditions. The question is not how might the system operate, but how does it operate?

The fact that a dead ear is unlike a living ear requires no explanation. I would, however, indicate the importance of quantitative measurements under test conditions. Runge, in the *Handbuch der normalen und pathologischen Physiologie* (1926), reports certain experiments on the relation of the external auditory canal to the acuity for hearing bone transmitted sound. He found that the acuity for bone transmitted sound was enhanced when the external auditory canal was occluded with a cotton paraffin plug (antiphon). This lateralization phenomenon, first described by the English physicist Wheatstone, was negligible when the external auditory canal was loosely packed with cotton, but not touching the drum membrane, before the antiphone was introduced. Removal of the antiphone, however, leaving the loose cotton in place, resulted in practically normal acuity for bone transmitted sound.

Runge feels that the cotton in the external auditory canal absorbs the sound vibrations discharged through the drum

membrane from the middle ear. He further deduces that the external auditory canal itself in no way influences the acuity for bone transmitted sound. Inasmuch as a mass of cotton in the external auditory canal does not affect the acuity for air transmitted sound, it would seem strange that it should show an absorbing effect when the sound is passed through it in the opposite direction. Runge's statement is quite opposed to the quantitative experiments of Kranz and myself on the influence of partial and complete occlusion of the external canal on bone transmission acuity. We, therefore, repeated Runge's experiment, using the bone activating receiver at 128, 256, 512 and 1024 Hertz. We found that cotton loosely packed in the external auditory canal has no appreciable effect on the acuity for bone transmitted sound at 128 Hertz, which conforms with Runge's observation. This was also true at 512. But at 256 Hertz a pronounced enhancement was established, and at 1024 a slight lateralization effect noted. However, on comparing the results of complete occlusion with cotton in the external canal and complete occlusion without cotton in the external canal, we failed to find any great difference in bone sensitivity. We therefore cannot agree with Runge's report and substantiate our own findings.

Runge also attempts to account for the differences between his results in the water filling test (Wheatstone) and the observations of Nagel and Samajloff, who used paraffin as a filler of the external auditory canal, on the basis that water is a conductive medium while paraffin is a nonconductive (?) medium. It may be pointed out that the differences between Runge's observations and those of Nagel and Samajloff cannot be explained on Runge's erroneous assumption that paraffin is a nonconductor of sound. Rather, the differences are explained by the fact that Runge used a living human ear recording sound, while Nagel and Samajloff employed a dead animal and manometric flame.

An oculist is supposed to be well oriented on the problems of physiologic optics. It will be a most excellent sign when the otologist finds it necessary to go back to school to inform himself concerning physiologic acoustics. Where indeed could an otologist go to learn of this most important subject? Surely

the time is ripe for the foundation of a unique research institute where proper equipment is available and where many investigators, each qualified in his respective field, may collaborate in a directed research on the deafened for the good of the deafened. The methods for accurately measuring the threshold of audition, both for air and bone transmitted sound, are available. The deafened will eagerly volunteer themselves for proper investigation of their condition. Why not prosecute the problem intensively? Why sit idly by waiting for some modern Moses who will lead the otologic children out of the bondage of tradition?

It is axiomatic that truth is naked and therefore carries no adventitious scenery as camouflage. It is also evident that facts are self selling and need no exploitation or advertisement. There are many theories of pitch analysis; in fact, they are so numerous and so varied that one is likely to suspect, quite without prejudice, that no one of them is even in part a correct interpretation. What may satisfy a morphologist is objectionable to a physiologist. What pleases the otologist meets with disapproval from the physicist. The psychologist appears to talk his own language and is not necessarily intelligible to any of the others. The statement of Waetzmänn that a workable theory of audition must conform with our ideas of resonance is, after all, the opinion of a most excellent physicist on a physiologic response.

Reduced to crude essentials, all theories of pitch analysis may be separated into two general classes. It is admitted by all that the neuroepithelium is an essential intermediate between the stimulus and the nerve ending of the cochlear ganglion. This is analogous to the condition in the eye where the rods and cones functionally lie between the light and the first retinal neuron. In other words, the light passing through the first retinal neuron has no effect upon it. Similarly, the sound passing through the first cochlear neuron does not directly effect a proper stimulus to the nervous system. In the case of the eye, the reaction of the retinal cells depends on the light passing through them, and is termed a photoelectric phenomenon—whatever that may mean. The response, however, is located intrinsically in the retinal neuroepithelium. Reasoning by analogy, the auditory epithelium may have an

intrinsic response to the sound passing through it, and this might be termed an acousticoelectric phenomenon—whatever that might be. The peculiar adaptation of the retinal neuroepithelium to its function in reference to light may be visually observed. Light and sound, however, are very different physical agencies. In the case of the ear, therefore, it might be necessary to hear the acousticoelectric adaptation of the neuroepithelium rather than to observe visually such adaptation. A theory of the intrinsic response in the cochlear neuroepithelium is peculiarly convenient, in as much as it explains nothing, and therefore may be entirely unobjectionable from the viewpoint of physics. The other general class of theories assumes an extrinsic response, which means that there is some structure applied to the end organ better adapted and more sensitive to sound analysis than the neuroepithelium itself, which pokes or prods these essential cells into an active response.

The theories of extrinsic activation may be divided into two varieties, one of which assumes a tuned system, the other an untuned system. The two chief representatives of the tuned system of sound analysis are at once the oldest and most recent. All theories take into account a liquid containing internal ear with two compartments, the scala vestibuli and the scala tympani, separated by the basilar membrane except at the helicotrema. The scala vestibuli is confluent with the perilymphatic area of the vestibule and semicircular canals. The footplate of the stapes is applied to the larger vestibular portion, while the scala tympani is completed by the membrane of the round window facing the tympanic cavity. The cochlear duct containing the end organ is separated from the scala vestibuli by the delicate vestibular membrane—at least it is delicate in mammals—and from the scala tympani by the basilar membrane. It will be remembered that the cochlear duct contains the membrana tectoria, which is applied to the ciliated end of the neuroepithelium.

The first theory of periodic response assumes a system of tuned fibers in the basilar membrane. Each of these fibers is supposed to react by sympathetic vibration to a given frequency and in this manner stimulate the group of hair cells applied to it. The theory believes that the basilar membrane

is built like a harp with the necessary differences in the length, the tension and the weight of strings essential to analyze the ten octaves of audible sounds. (Some harp!) Were the basilar membrane or even the tectorial membrane really built on this pattern, which they are not, and were the requirements in string length, string tension and string mass fulfilled, what, after all, does this explain? The next question would be: Who tunes these structures? How is it possible for the two ears of an individual to be tuned alike and maintain this discrete pitch analysis throughout life? A workable theory of hearing must certainly include the fact that each individual has two ears. A clear explanation of a given phenomenon does not consist in merely passing the buck. Serious physical objections confront this theory of sound analysis. Accordingly, because of the various mechanical impossibilities to accomplish the desired result, the theory has recently been modified to eliminate objectionable features in the tuning.

The most recent of the theories of pitch analysis assumes a weighting effect on the basilar membrane through the liquid applied to its two sides. The weighting of the membrane might vary with the distance of the given point from the two openings into the cochlea and might, therefore, compensate for discrepancies in the length, tension and mass of the basilar membrane fibers. Accordingly a low pitched sound requiring greater weighting and less tension for its analysis would affect the apical end of the basilar membrane. High pitched sounds would correspondingly have their effect on the shortest part of the basilar membrane nearest the two windows. The tuning is therefore indirectly accomplished through interaction of the two windows and the selective weighting of the basilar membrane. This theory, while mechanically possible, does not appear to conform with facts. It is known that individuals may have unilateral effusion into the middle ear, and that this liquid may mount to the level of the round window. Under these circumstances the interaction of the two windows and the weighting of the basilar membrane would be mechanically altered. Accordingly an individual with unilateral middle ear effusion should report "false hearing" in that ear when the stem of a vibrating fork is applied to the head, and should complain of pronounced diplocousis to air transmitted sound.

Politzer states emphatically that diplocousis under these conditions does not occur. It was pointed out at the Montreal meeting of 1926 that this theory proposed by physicists goes on the reefs of otologic experience. The objections to a direct tuning of the individual fibers of the basilar membrane, and the failure of the weighting to correct obvious physical defects in this manner of resonant reaction, are even more serious when applied to the *membrana tectoria*. The tectorial membrane, because of the manner of its attachment, its structure and a specific gravity—practically that of the liquid in which it is immersed—is even more poorly adapted to accomplish the function ascribed to it. Surely the failure of a tuned system in reference to the basilar membrane cannot be construed as evidence in favor of the only other extrinsic structure associated with the organ of Corti. It has been maintained, for example, that sharp areas of lowered acuity in the auditory field must represent local defects in the structures associated with the end organ or in the end organ itself. Kranz and I have demonstrated, in the only cases thus far investigated quantitatively both for bone and air transmitted sound, that the markedly lowered acuity found in our series at about 2,500 p. p. s. are probably not located in the internal ear at all. The so-called tone gaps described by Bezold cannot be said to be definitely established.

If the theories of periodic tuning do not fit the facts, let us see in what manner the consideration of an aperiodic system fulfills the known requirements. Suppose the vibrations of the stapes footplate agitate the liquid of the perilymphatic space, then the membranes interposed between the *scala vestibuli* and *scala tympani* would be set into vibration. These vibrations might be of the membranes as a whole—that is, the telephone theory—or might result in the formation of hills and dales through a segmental response in the membranes affected. The hill and dale effect would naturally vary with the pitch, and accordingly a sound pattern might be developed in the membranes, thus affecting the end organ variably throughout its entire length. It has been demonstrated, and even photographically recorded, that small homogeneous membranes immersed in liquid under conditions mechanically similar to those found in the internal ear may develop such patterns. The

aperiodic theories agree nicely with the aperiodic responses in the ear, which, unlike a telephone receiver, shows no peaks at definite frequencies. Kranz has demonstrated this aperiodic response with his continuous tone range audiometer. It might be noted parenthetically that an attempt to place a free period of about 1,200 p. p. s. in the ossicular apparatus through mathematical computation meets with the experimental objection that the ear shows no evidence of a free period at this pitch level.

The major objections to the pattern theories, whether directed toward basilar or tectorial membranes, are easily understood. The entire physiology of the nervous system is based on a nonspecificity of nerve impulse. This is borne out through the evidence submitted by Brouwer in the rereversal of retinal images through rearrangements of the optic tracts in such a fashion that the relay station (lateral geniculate) receives the code message right side up. If we are to grant a cortical analysis of the hill and dale patterns in the internal ear, we must also make assumptions quite contrary to our experience on the function of other sensory components of the nervous system. This objection also holds for the nonselective telephone theory.

It has been stated that vibrations have produced hill and dale patterns in small homogeneous immersed membranes. These vibrational results, however, do not necessarily correspond to the effects of sound as heard by a living ear. Kranz has shown that at minimum audition for the pitch 2,000 p. p. s. the actual air particle displacement in the external auditory canal is about one forty-millionth of a millimeter. The human ear shows the phenomenal capacity of being able to tolerate one million millions times the intensity required for minimum audition. Knowing that the intensity varies as the square of the velocity, the square root of the known intensity increase gives us the actual amplitude increase. The amplitude increase for one million millions times minimum intensity would therefore be one million, or an actual air amplitude under this condition of one-fortieth millimeter. Granting that the full amplitude thrust on the drum membrane might be transferred to the stapes (which it is not), the vibrations of the stapes at this

phenomenal intensity would still be less than one-fortieth millimeter. If the amplitude reactions in the basilar membrane were split up into a number of components analyzing a compound wave, the sum of all these hills and dales would not be greater than one-fortieth millimeter, or roughly, one-thousandth of an inch. A pattern of this kind would hardly lend itself to photographic reproduction.

Kato demonstrated in the living animal that when the tensor tympani was stimulated electrically and caused displacements of the drum membrane far beyond any responses possible through applying sound, no displacement could be demonstrated at the round window, even under considerable magnification. Cutting the tendon of the stapedius, however, resulted in prompt pressure responses of the round window. The experimental evidence derived from models or even from dead animals cannot therefore be applied directly to the behavior of a living ear.

The aperiodic theories of pitch analysis, therefore, do not interpret the end organ responses any better than do the periodic theories. At least, when facts oppose theories let us stick to facts. I appreciate this arraignment, and perhaps this destructive criticism may appeal to some as entirely unwarranted. Let us not, however, be depressed because we know nothing definite of pitch analysis. Even if we did know exactly how this analysis occurred, we would not on this account be in a better position to offer helpful suggestions in the treatment of the deafened. Deafness is largely a result of lowered intensity registration, not of pitch analysis. Let us, therefore, study the available apparatus in reference to intensity registration. Let us see how it is possible for a normal human ear to tolerate without discomfort the intensity factors required for those who are quite deafened—say, one thousand million times the intensity required for normal minimum audition. Let us consider if it is possible for an individual to possess a competent end organ insulated off, as it were, from even excessive sounds, just as a normal retina may be insulated off by a cataract. Let us consider the mechanical aspects of this part of the problem rather extensively, because upon its proper evaluation rests not only some hope for the majority of deafened people but also some possibilities in preventive treatment.

If we are to consider the possibilities in the behavior of the auditory apparatus in reference to intensity registration, we must presuppose certain information on the physics of sound. I have therefore prepared what might appeal to a physicist as a kindergarten series of experiments. The purpose of the demonstration is not to exhibit my own ignorance, but rather to show how little fundamental information is required to follow the remainder of the argument without extraordinary difficulty.

Sound is propagated by a longitudinal wave motion. A simple method to illustrate a longitudinal wave is to first show what it distinctly is not. One may go to the seashore and perhaps may see, some distance out, a log rising and falling on the waves. One might appreciate that the water rushing toward the shore will gradually work the log closer and closer to land. As a matter of fact, the log will merely continue to rise and fall on each succeeding wave without changing its position. The water is lifted and lowered as the wave rushes on. The amplitude of the wave is represented by the rise and fall of the log, above and below the mean level. The length of the wave is determined by the distance which the wave has traveled in one complete excursion of the log. The force exerted by the wave is at right angles to the direction of propagation (transverse wave motion). In sound, however, the force of the wave is parallel to its direction. The particles of the medium therefore undergo excursions like a pendulum, and in order to figure this motion graphically the longitudinal wave is translated into a transverse one.

The pendulum, starting from the vertical position, swings to one extreme of motion in the first fourth cycle; the next fourth cycle is occupied in returning to the starting position; it overswings to the other extreme of motion and returns to the vertical in the other half cycle. The frequency of the pendulum is dependent upon the length of the radius, and the amplitude is represented by the arc distance. The frequency of the pendulum may be altered by changing its length—its physical condition.

The progressive pendular motion illustrating a longitudinal wave may be demonstrated with a row of blocks. The first block knocks down the second, and the wave is propagated

through the entire series to the last block, which kicks out in the direction of the wave motion. The distance this wave ran in one second would represent its speed. The wave length would be determined by the distance the wave traveled during one complete pendular excursion of any one block. Propagation of sound does not involve inertia. If I swing a pendulum, it tends to keep on swinging. When a single sound pulse is sent through a medium, each particle of the medium undergoes one complete pendular motion and no more. Each particle responds once to each passing pulse just as a log on the water rises with each wave. Transmission without inertia implies that sound travels from a given source with uniform speed so long as the medium through which it travels is constant.

I have here a liter graduate and a fork. If I apply the prongs of the vibrating fork to the mouth of this cylinder, a resonance will take place. When a train of sound waves enters the mouth of the cylinder it travels to the bottom and is reflected back toward the source. The air molecules are undergoing pendular displacements and are swinging up and down. If the length of the cylinder is such that the reflected wave pushes against the pendular motions of the molecules at the mouth of the resonator just as they have swung back to neutral, then the pull on one side is reinforced by the push on the other side, and an amplitude of reaction is built up. This is a standing wave with the loop at the mouth of the resonator (maximum motion) and the node at the bottom (maximum pressure). It is this increased amplitude which makes the resonator speak out.

The time it takes the sound to go to the bottom and to come back to the mouth of the resonator is, therefore, one-half of the wave length, or four times the length of the resonator is the complete vibration period. The speed of sound in air is about 330 meters to the second which, divided by four times forty-four cms., will give us the pitch of this fork—187 vibrations, or, as the Germans now term it, Hertz.

All gases are equally elastic but their density varies. If I add carbon tetrachlorid to this resonator, the heavy vapor will affect the density of the gas without affecting its elasticity.

Note—the resonator does not respond to the determined frequency of the sound in air. When I add water to shorten the column of gas in the cylinder, the resonator will speak out when the proper length is attained. This demonstrates that the wave length in air changes to the wave length in the mixed gas. I can also change the elasticity of a medium without affecting its density. It is well known that the prongs of a tuning fork vibrate transversely with the loop at the free end and the node toward the shaft. Therefore as the prongs approach and separate, they raise and lower the stem of the fork, with the result that the stem vibrates longitudinally. If I activate this fork and place the stem on the resonant table top, the table offers a large area for the transfer of the vibrations to the air. If I place a vulcanized rubber rod between the stem of the fork and the table top, one would suspect the maximum amount of vibration would be transferred from the stem of the fork to the rod when the latter is perpendicular. Suppose I bend this rod. A maximum effect is noted when the rod is bent to a critical point. I have put the rod under tension and have changed its elasticity so that a loop is developed on each end. Under these circumstances the rod will transfer the greatest amount of vibration. The maximum motion is at the two ends of the rod, and if it is exactly of one wave length, then the particles in the middle of the rod do not move at all, and the two ends are moving in opposite directions. This is, therefore, an example of a standing wave in a solid object and an excellent demonstration of longitudinal wave motion. Sound, therefore, travels by longitudinal wave motion and with constant speed so long as the medium remains constant. The number of waves per second represents the pitch and the amount of molecular displacements represents the amplitude.

Sound tends to reflect back at every change of medium, and the amount of back reflection is dependent on a number of factors. Suppose I take this same fork and place the stem into a dish of water on the table. The change in the character of the medium from steel into water is very abrupt. If I had a barrel of molasses and introduced a small spigot, no molasses would flow out because of its viscosity. It would be necessary to use a large spigot. I may apply this same prin-

ciple to the vibrations of the fork stem and provide a large area for the discharge of the vibrations into the water. The effect is easily heard. A vibration in water one-thousandth of the amplitude of a similar vibration in air has the same intensity. May I remind you that the drum membrane surface is much wider than that of the stapes. The area ratio of stapes to drum membrane should be one to thirty-three ($^2\sqrt{1000}$) to efficiently transfer vibrations from air into water.

Some two years ago I read a paper on the acoustic insulation of the labyrinth. It was mentioned at this time that sound was transmitted through all media. Obviously the only possible condition of insulation is nothing—a vacuum. Sound, however, may destructively interfere with sound on the one hand, and sound effects may be made to cancel sound effects on the other hand. It is well known to otologists that a tuning fork has four dead spots. This may be illustrated by rotating the vibrating fork over the resonator. The phenomenon is dependent on two sources—each prong. If the distance from one prong is such that the sound pulse from this source meets the sound pulse coming from the other prong in half phase, then condensation cancels rarefaction and the spot is dead. This destructive interference is necessarily dependent on two sources delivering a sound of equal pitch and equal intensity. The interference effect cannot be applied in terms of an ear where the entire apparatus is extremely small in reference to audible wave lengths and where the pitch and the intensity are variable. The otologist is necessarily careful in exhibiting the fork at the external auditory canal because the fork must occupy a definite position, otherwise the test is useless.

The phase relations of sound are easily illustrated. Suppose two men working on the same end of a cross cut saw; if one pushed as the other pulled, no work could be accomplished. Suppose now I placed the two men on the opposite sides of the log, then when one pushed and the other pulled a maximum effect would result. If both pushed or both pulled, no work would be done. This same result may be obtained in the reactions of a diaphragm to sound. A maximum effect will take place when the sound is applied only to one side of the diaphragm. No effect will result if the given sound is applied

to both sides of the diaphragm. Meissner applied this simple principle to the aeroplane telephone transmitter. The roar of the engine is transmitted to both sides of the diaphragm and therefore cancels. The speech is applied to only one side of the diaphragm and is therefore transmitted. The usual type of telephone transmitter for this reason is a closed back type. This form of transmitting mechanism may be directly applied to the ear in the drum membrane, and for the drum membrane to operate efficiently the auditory tube must be closed (solid back transmitter). Kranz and I have shown that occlusion of the external auditory canal affects but little the intensity of low pitch air sounds, while the high pitches may be markedly decreased in intensity. This means that if the auditory tube were functionally patent the sensitivity of the transmission system would be tremendously decreased. If a boiler maker could open his auditory tube voluntarily, he would be protected from acoustic insult. In as much as plugging his ears will not protect him, the prevention of boiler makers' deafness is a simple matter. He should use rubber rivets and a felt hammer or substitute the electric welding process, which makes no noise. It goes without saying that the middle ear cannot be constructed on a sound cancellation basis, and therefore we cannot find in it a direct mechanical explanation for a protection to the internal ear against acoustic insult. Let us therefore turn our attention to the internal ear and see if the physiologic interpretation of its structure, usually associated with the function of pitch analysis, may lend itself to the conception of sound cancellation. Please remember that a million (1,000,000) times the threshold stimulus may be exhibited before the sensation is even painful, let alone destructive. Let us see if the principle of sound cancellation illustrated in the aeroplane telephone transmitter may be used in explaining an automatic intensity control in the internal ear itself.

Let us first consider the relations of the internal ear briefly. The oval window occupied by the stapes footplate faces the vestibule, which is continuous with the scala vestibuli on the one side and the perilymphatic semicircular canals on the other side. The scala vestibuli extends to the apex of the cochlea and is separated from the cochlear duct by the delicate vestibular membrane. It is, therefore, indirectly related to the

basilar membrane through the ectodermal cochlear duct. The scala vestibuli becomes confluent with the scala tympani through the helicotrema at the apex of the cochlea. The scala tympani ends blindly at the round window and is separated from the air containing middle ear by the elastic membrana tympani secundaria. Let us suppose that each window was closed in by similar membranes facing the tympanic cavity. Then the pressure of the sound would register against the entire middle ear area and would pass through all structures. Let us assume the basilar membrane behaves like a telephone transmitter diaphragm; then if equal intensities were applied to each side, the vibrations would cancel each other. This would be the same, whether a helicotrema was present or not. Suppose the intensity of the sound transmitted to the oval window was greater than that passed through the round window. Then if a helicotrema was present the higher pressure on the vestibular side would tend to escape through basilar membrane and through helicotrema to the lower pressure on the scala tympani side. The effect on the basilar membrane would necessarily be less pronounced with the helicotrema open than with the helicotrema closed. In other words, the helicotrema may be nothing more than an automatic shock absorber.

The amount of sound transmitted to the perilymph, as opposed to the amount transmitted into the bony capsule, is difficult to determine. The idea to be conveyed, however, is that sounds must pass into the perilymphatic space through both windows. It is unnecessary to assume that when one window area is displaced inward the other window area must be displaced outward, because the pressure in the internal ear varies with that of the pulse. Perilymphatic pressure may, therefore, be adjusted quite automatically by the blood lymph circulation. We have good evidence that a person may be relatively deaf to air transmitted sound and still show quite perfect reactions in the end organ. A case in which a double radical mastoid operation had been performed was carefully investigated by Lillie and Kranz. This individual was deafened throughout the field of audition by a factor of 1,000 millions times the minimum normal intensity required to hear. When cotton prostheses were applied to his middle ear, his acuity for hearing air transmitted sound was increased by a factor of about 1,000;

his deficiency, therefore, under these conditions was only 1,000,000.

The obvious interpretation of this case is that when 1,000 millions intensity was applied directly to the middle ear, the amount passing in through the two windows practically canceled. The cotton protheses acted by affording a better transmission to the stapes footplate or the promontory, which corresponds to the vestibular area of the first cochlear turn. This reinforcement to air transmitted sound obtained throughout the entire scale and was as pronounced at 2,500 Hertz as it was at 500. It is generally assumed that the sound transmission system represented by a drum membrane and an ossicular chain is more efficient in the transmission of the lower than of the higher frequencies. The cotton protheses represented a false drum membrane and ossicular chain, and should, therefore, have reinforced only the lower frequencies; if anything, they should have interfered with the higher frequencies. This, however, was not the case. The very fact that the end organ operated more efficiently with the protheses in place shows that sounds striking the stapes footplate and the round window tended to cancel in the internal ear, and not until additional intensity was developed in the scala vestibuli did the end organ show more efficient response. It is my conviction that the idea that the drum membrane and ossicular chain act most efficiently for the lower frequencies and have little or no influence on the higher frequencies does not fit the facts. I feel that the deafness in this individual was almost entirely due to the physical defect in the sound transmission system, and his prompt reaction to the cotton protheses suggests that his lowered acuity was dependent on a violation of the physical conditions under which the end organ nominally operates.

The second case is one in which a deafened individual showed progressive loss of acuity after ossiculectomy. His physician in examining the middle ear discovered the discolored tip of the stapes embedded in the redundant tissue about the promontory. The bone was evidently necrotic and had separated itself from the periost on the labyrinth side. The stapes was extracted and the patient showed pronounced labyrinth disturbance. The labyrinth, however, was not open. The patient then heard a whispered voice across the room,

but within 24 hours was back to the condition of shouting deafness. The explanation is not to be found in the awakening of an end organ reaction through auditory shock but rather to the change in the physical relations of the two windows. When the stapes was extracted, the oval window may have transmitted more sound than the round window, but as soon as the exudate filled in the spot formerly occupied by the stapes the two areas balanced again and the result was a markedly reduced acuity for hearing air transmitted sound.

This individual, however, could hear bone transmitted sound fairly well. He could understand my German quite readily through a bone activating receiver, and although it required a great deal more than a normal intensity, he could recognize a distinct foreign flavor in my accent. Remembering this individual had no stapes on one side and did not seem to lateralize to the side in which the stapes was preserved, it indicates that bone transmitted sound was still perceived in spite of the removal of the entire sound transmission system. This may be interpreted by the greater area relation of the bony vestibule and semicircular canals to the perilymph on the scala vestibuli side. There may also be greater possibilities of a yielding in this region which might cause a more efficient discharge and therefore a relatively greater intensity on the upper surface of the basilar membrane. Accordingly, the most pronounced sensitivity for bone transmitted sounds should be exhibited by individuals with a normal air acuity. This is in keeping with the work done at the Riverbank Laboratory and with our report that prolonged bone transmission is not a real phenomenon, but is dependent on the more pronounced masking of the normal hearing observer by the adventitious noises in the otologist's office. In a word, prolonged bone transmission is quite the same sort of thing as paracousis Willisii for air sounds. So far as I am aware, there are no instances of prolonged bone transmission.

The physics of a sound cancellation effect makes it possible to explain the phenomenal acoustic insulation of the internal ear and assumes that the neuroepithelium is directional in its action. The vibration to be effective must strike the organ of Corti on the vestibular side. This appears to account for the possibility of excellent hearing in a greatly deafened indi-

vidual when sufficient but not distorted intensities are created. This conception of internal ear mechanics provides a shock absorbing system which automatically controls the intensity and appears to interpret the anatomic relations more satisfactorily than do the theories of pitch analysis. May I also add that sound cancellation in the internal ear is not mechanically opposed to any and all varieties of theories on pitch analysis?

An internal ear with similar windows facing the middle ear cavity might therefore be quite deaf to air transmitted sound until sufficient intensity was attained to activate it through the otic capsule (bone transmission). This theoretic condition, however, does not obtain in cases of ossiculectomy, because the stapes area is greater than that of the round window, and the thrust of the bony footplate of the stapes against the perilymph is undoubtedly more advantageous than that of the membrane of the round window against the liquid of the scala tympani. Ossiculectomy may actually improve the hearing in cases where the stapes is quite loose, because under these conditions the outer ossicles may weigh down the stapes and actually interfere with its vibrations. The amount of increase in acuity of hearing air transmitted sound does not appear, as a rule, to present the individual with an enhancement of audition to the point of economic value.

The theoretically deafened ear operating under conditions where similar quantities of sound stimulus are being transmitted to the two scalæ may be adapted to the requirement of acute hearing for air transmitted sound through the development of a middle ear. This requirement would be met by a drum membrane flanked with air on both sides and a solid transmission system to concentrate the drum membrane vibrations upon the stapes. It has been pointed out that a vibration in water of the same amplitude as in air exerts 1,000 times as much pressure. This means that when vibrations in air are projected directly against water, they would be almost entirely reflected back. The physical condition calls for a drum membrane area of $\sqrt{1000}$ times that of the stapes area, or a ratio of 33 to 1, granting, of course, that nothing is lost in transmission and both ends of the apparatus are 100 per cent efficient, which, of course, they are not. In any event, for the

efficient transfer of air vibrations to the perilymph, the drum membrane area must be considerably larger than that of the stapes footplate. It might also be anticipated, because the ear is one of the most sensitive of distance organs, that the greatest efficiency in the apparatus would be developed for faint sounds. It is fair to assume that the internal ear operates under conditions of microscopic or even ultramicroscopic displacements in the perilymph, and that these ultramicroscopic displacements lie well within the elasticity of the liquid.

It was mentioned that the middle ear operates under conditions similar to those found in the solid back telephone transmitter. If sounds were to strike both sides of the drum membrane, a cancellation effect would result. The deep surface of the drum membrane is flanked by the air of the normally closed tympanic cavity. The closed tympanic cavity, however, must necessarily have temporary connections to the outside, because any moist vascular surface may absorb air as long as its tension is higher than that of the gas tension in the tissues. The opening of the auditory tube will, therefore, tend to equalize the pressures on the two sides of the drum membrane. Kranz and I have demonstrated the decreased acuity both to air and bone transmitted sound under conditions of plus and minus pressure variations in the air of the external auditory canal. There does not appear to be any definite experimental evidence that this transient tubal opening occurs with each act of swallowing. This statement was considered in some detail at the Montreal meeting in 1926.

The development of a functionally sealed cavity with relatively large surface of absorption and small surface for pressure adjustment (drum membrane) results in another adaptation. The pressure against the drum membrane necessarily varies with that of the barometer, and the sound transmission system appears to show an adjustment toward this requirement. This adjustment is found in a kinking of the sound transmission apparatus, which permits relatively large excursions in the drum membrane with minimum displacements at the oval window. This adjustment feature, according to the writer, was mistaken by Helmholtz as a leverage system which reduced the amplitude of drum membrane vibrations and

therefore increased the force applied to the stapedial footplate. The conception that the leverage system operates in terms of sound vibrations must be deleted, because it is not in keeping with the facts.

It has been maintained that the umbo of the drum membrane affords a better adapted area for sound reception than if the drum membrane were flat. This does not appear to be a true statement, either on the basis of physics or on that of comparative physiology. The drum membrane, by reason of its construction and attachment to the handle of the malleus, is thoroughly damped. It can under no circumstances respond to the full amplitude of the air transmitted sound. The vibrational reaction in the drum membrane is undoubtedly appreciably further lessened through the additional weighting and attachment of the ossicular apparatus and its associated structures. Were it not for the air absorption in the middle ear and barometric fluctuations, a straight, free floating transmission system from drum membrane to stapes would function as well or even more efficiently than a segmented ossicular chain.

It has been maintained that the drum membrane and ossicles function for the transmission of low pitch sounds, while high pitch sounds pass on directly to the labyrinth. This assumption is based on the investigation of typical conduction deaf individuals who appear to be deafer to the lower than to the higher frequencies as developed by tuning forks. The case of Lillie and Kranz previously mentioned does not harmonize with this statement. The reports of Kranz and myself on the quantitative tests on eight deafened ears and on several ossiculectomy cases show with but one exception that this assumption is by no means well established. I therefore cannot agree with the accepted opinions on the influence of the sound transmission system in cases of conduction deafness.

Kranz and I found, in a case of ossiculectomy, that while the sensitivity to air transmitted sound was greatly reduced (factor of 200,000,000), the noises readily tolerated by a normal ear produced painful sensations. In fact, this woman when led into a reverberant room immediately placed her hands over her ears when loud sounds were produced, like a

shout or clapping the hands. The interpretation is not that she was more sensitive to low pitch sounds, because her acuity curve was practically flat throughout the audible range. It is not unlikely that the threshold intensity necessary to transmit sound to the labyrinth lay fairly close to the intensity required to produce clatter in the extremely light stapes with no muscle to control it.

If now the ossicular chain is segmented to permit a maximum motion at the drum membrane end and a minimum displacement at the stapedial end, then muscles must necessarily be developed to control the movements of these segments. The writer has reported how it is possible for a double muscle in the mammals to be replaced by a single muscle in the birds. It is, of course, well known that the tensor tympani and stapedius are muscles of opposition, which balance the ossicular chain and regulate the perilymphatic pressure.

Recent evidence, however, appears to demonstrate that the muscles are not opponents; they do not balance the ossicular chain, and they are not concerned in maintaining the pressure in the perilymph. The stapedius may contract and relax quite independently of the tensor tympani. The prime function of these muscles is to adjust the variable sound transmission system to positional variations of the drum membrane. They also appear to contract as a result of acoustic stimulation. Perhaps the following tentative explanation may be acceptable in the interests of clearness. If the amount of vibrational reaction rises to the point where the lightest element—the stapes—starts to clatter, then the stapedius may contract to prevent this. If the intensity is still further increased to the point where the drum membrane and outer ossicles clatter, then the tensor tympani contracts.

It is well known that cochlear degenerations which result on account of prolonged acoustic insult do not appear until the intrinsic muscles are fatigued. There is a veiled suggestion in this explanation of muscle response that the cochlear degenerations may result from the clatter in the sound transmission system.

Our accepted conceptions of the sound transmission apparatus and the function of the middle ear seem to be based on

the evidences found in dead animals and on all too obvious explanations of structural relations.

It must surely appeal to the reader that a great deal of conjecture has been built up upon slender foundations. Guild makes a startlingly similar statement on the basis of his accurate measurements on the basilar membrane of the guinea pig. We appear to know too much of that which is mistaken for fact.

The vast majority of deafened people come to the otologist, or rather go from otologist to otologist, with a very similar story. They are Rinne negative types. They show little or no lateralization of bone transmitted sound on occlusion of the external auditory canal (Weber-Wheatstone negative). They show evidences of prolonged bone transmission (pseudo-prolonged). They agree they hear more acutely in a noisy place or in a street car or automobile (paracousis Willisii). They show prompt and sometimes even remarkable enhancement to air acuity through use of the acoustic fan. The acoustic fan, in passing, is a very important test apparatus in any otologist's office. They tend to speak in a voice of low intensity and may even hear themselves whisper. In a word, there is good evidence that such individuals possess an excellent functional end organ and central apparatus.

According to the doctrines proposed in this paper, these individuals are suffering from a disability in the sound transmission apparatus. I have two suggestions to offer and may be permitted to outline the possibilities of a defective mechanism. Let us consider briefly an obvious sequence of events. Prolonged air absorption through occlusion of the auditory tube results in a medial drum membrane displacement. If this condition of displacement is continued, the tensor tympani muscle will adapt itself to the new position taken by the malleus. The muscle may therefore undergo an actual contracture or the tendon may become adherent to the processus cochleariformis. Inflation of the middle ear may give prompt relief if accomplished before an actual contracture or adhesion of the muscle takes place. This relief may be permanent if the tuba is capable of assuming its normal function. After contracture or adhesion has taken place, insufflation of the middle ear will not give relief, because the drum membrane is practically fixed

in position. Under these conditions the vibrations of the drum membrane are not carried over efficiently to the stapes, and the individual is correspondingly air deafened. This type of case will show no lateralization of bone transmitted sound on occlusion of the external auditory canal. This sign is quite definitely correlated with the lowered air acuity and seems to show that the individual's drum membrane and outer ossicles are of little use to him. All of the armamentarium required to establish this condition is a tuning fork somewhere between 256 and 512 Hertz to determine absence of lateralization to bone transmitted sound and an acoustic fan to establish the enhancement to air transmitted sound and speech through the teeth.

The second possibility seems to conform with Runge's description of the ankylosis of the malleus-incus to the tegmen: in a word, to a bony integration of the outer ossicles with the skull. I emphasize this second possibility of mechanical defect in the ossicular chain because acute hearing is found in the rabbit, where malleus and incus are fused, and also in small rodents and carnivores where the anterior process of the malleus is ankylosed to the annulus. The interference, to be an efficient barrier to sound transmission should therefore be located along the plane of transmission, and suggests the contracture and adhesion of the tensor tympani as the possibility and the ankylosis of the malleus-incus to the roof of the middle ear as a second. The third possibility is naturally found in the ankylosis of the stapes itself.

What might be done for such individuals? The first step is the investigation of the entire sound transmission system with an acoustic probe. This miniature type of bone activating receiver is now under construction at the Riverbank Laboratory. The drum membrane may be reflected back and under local anesthesia the intensity required for the activation of the end organ from the handle of the malleus, the long process of the incus, the stapes, and the promontory may be quantitatively investigated. The information obtained by feeling one's way along the transmission system might determine where the disability was actually located.

If it is found that the tensor tympani has actually undergone contracture or is adherent to the bone, then the tip of the

processus cochleariformis may be removed. This procedure will not only loosen the muscle from its adhesions but will lengthen it through taking the tendon over the hypothenuse rather than the two sides of the triangle. I have accomplished this operation on cadavers, and the resulting lengthening of the muscle (practically 1 mm.) is quite sufficient to accomplish the desired result. If the interference to the sound transmission is dependent on contracture or adhesion of the tensor tympani, the patient should immediately report a great enhancement in acuity of hearing. I am assuming this on the basis of a single case examined by Kranz and myself, where the reinforcement to air transmitted sound by holding the acoustic fan between the teeth was a factor of 76,000 at 512 Hertz. The operation of lengthening the tensor tympani muscle, while by no means simple, may be accomplished and will be developed.

Should the deformity in the sound transmission system be found in an ankylosis of the malleus-incus at the superior ligament, then an operative possibility must be developed to eliminate this integration of the ossicles with the skull. This operation, while technically more difficult, is also a possible one.

In conclusion, may I express the opinion that many cases of lowered air acuity are due to secondary deformities of the sound transmission system. These deformities are probably amenable to mechanical correction once the physics of the sound transmission system is thoroughly established and proper methods devised for determining the position and the character of the lesion. A reflected drum membrane and an acoustic probe may give information on the location of the interference and may separate the cases of deafened individuals into a class which may be operatively corrected and a class where operative interference is not indicated. It has been shown that the test methods commonly employed do not establish either the position or character of the lesion nor are they necessarily a criterion of the acuity of hearing in so far as economic conditions are concerned.

Perhaps the viewpoint on the problem of deafness given through morphologic study and the testing of normal and abnormal individuals with quantitative methods may be stimu-

lating to those who agree with me that something more can be done because something more *must be done*.

It has been my privilege to enjoy the unusual facilities offered by the Riverbank Laboratory, through courtesy of Colonel George Fabyan, and the unusual opportunity of collaborating with my colleague, Dr. F. W. Kranz, whose ingenuity and interest have made possible quantitative methods of research throughout the audible range on the acuity both for air and bone transmitted sound. I also wish to acknowledge the courtesy and wholehearted cooperation of Colonel John Paegelow, Commandant at Scott Aviation Field.

LII.

OTITIS MEDIA IN INFANTS.*

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A syndrome of intestinal disturbances produced by otitis media in infants has been described frequently during the last two years. Hartman¹ of Berlin, in 1898, concluded that, first, an otitis media may be accompanied by disturbances of nutrition, as evidenced by dyspepsia and emaciation; second, that upon evacuation of the contents of the middle ear through paracentesis disturbances in digestion disappeared and an increase in weight followed; third, elevations of temperature occurring in the report of intestinal disturbances might be referred to complications of otitis; fourth, in all intestinal infections of infants accompanied by elevations of temperature and reduction of weight, an examination of the ears for the possible presence of otitis should not be neglected.

Dean, in discussing Lyman and Alden's² paper, "Gastrointestinal Disturbances in Infants," reports several cases of acute otitis media seen in the pediatric service at the University of Iowa. He saw, during the winter of 1921 and 1922, with Byfield, an infant with acute otitis media, on a Saturday night. A myringotomy was done, and as the ear condition was not alarming, he said that he would see the case the following Monday. Inquiring about the case on Monday, he found that the child had died on Sunday. The cause of death was found at necropsy to be acute suppurative mastoiditis with toxemia. A week later, another baby died in the pediatric service, which had not been examined by the otolaryngologic service. The pathologist, at autopsy, reported an unsuspected bilateral acute mastoiditis with toxemia as the cause of death. Dean became alarmed, and during the winter more mastoid operations were done than during all the previous years. His observations at this time were really the beginning of our work

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with acute otitis media in infants. Alden and Lyman² reported seventy consecutive autopsies on infants who had died from athrepsia and infantile diarrhea, and stated that suppuration of the middle ear was found in all of the cases. Thirty cases had been diagnosed as acute otitis media in life, while forty additional ones were found at autopsy.

Marriott³ concluded that "acute nutritional disturbances in infants, associated with diarrhea, fever, hydrolability and toxic symptoms, are not the result of a food or alimentary intoxication in the same sense that some particular element of the food is at fault. With intestinal infections and food poisoning ruled out as factors, we are forced to conclude that there must be some metabolic disturbance or a toxemia of infectious nature." He found at autopsy no lesion of the gastrointestinal tract or infectious foci in the cases examined. Two years later, more complete autopsies were done on infants succumbing to nutritional disturbances, and the mastoid antra in a large majority were found filled with purulent material containing hemolytic streptococci. This occurred in patients upon whom a myringotomy had been done some time previous to death, and led Marriott to conclude that myringotomy alone was not sufficient to secure ample drainage of the mastoid antra.

Jeans and Floyd,⁴ in 1926, called attention to the fact that mastoiditis and nasal sinusitis might produce a clinical picture identical with that known as "cholera infantum," and that these infections were the common cause of a definite clinical picture. They say, "In a number of instances of death in what seemed to be 'cholera infantum' the only pathologic finding of importance was in connection with mastoiditis or nasal sinusitis." That this is more than a coincidence has been shown definitely in numerous instances, because of the exceedingly prompt recovery from the constitutional disturbance upon the establishment of drainage.

Reinaud⁵ found, without exception, the presence of diffuse suppurative lesions of the ear extending to the whole petrous bone at the postmortem examination of seventy infants at the Bettonean Hospital in 1921.

Gompres⁶ writes of systemic disturbance which he believes is due indirectly to infections of the middle ear.

Byfield⁷ says, "A recent experience with very young infants has confirmed the reports of certain French clinicians, who have assumed that the infected mastoid antrum may lead to severe gastrointestinal and grave nutritional diseases." He reports that three infants under two months of age died with a syndrome of gastroenteritis, dehydration and acidosis, and at autopsy in each case only infected mastoid antra were found. The condition was recognized in the next six cases and but one died.

Drury⁸ and Preysing⁹ have recognized and reported similar conditions.

Le Mee and Bouchet¹⁰ have reported numerous cases of infants in which pus has been found in the middle ear at death. They offer three explanations: First, "the presence of pus in the tympanic cavity is an agonal event." We have seen only one example in which pus in the middle ear might have been a terminal infection. This was an infant about one year of age, who died of miliary tuberculosis. No previous examination of the ears had been made, but a small amount of thin white pus limited to the tympanum was found at necropsy. Second, "this pus is of an exogenous nature; it is not a case of true otitis but one of a sort of empyema of the middle ear, which is a supplementary reservoir for the pus of the cavum." Veillard maintained that in 30 per cent of postmortem examinations the cavities of the middle ear are found to be filled with mucopus, which, if removed by irrigation with water, left the mucosa and ossicles in a healthy condition. Le Mee and Bouchet¹⁰ attempted to prove that a liquid could enter the middle ear, either by force of gravity or by capillarity. They instilled a solution of methylen blue in the nasal fossæ of infants with infections in the nasopharynx. Very often, several days later the tympanum would be greenish in color, indicating that the methylen blue had reached the middle ear. We have noted that practically all the infants in the pediatric service are fed lying on their backs, and in many cases infections of the nasopharynx exist. Rarely are changes in the drumheads seen in these cases. We feel that if mucopus of an exogenous nature fills the tympanum, which is thus created as a supplementary reservoir for the pus in the cavum, certainly obvious changes

in the drumhead should take place. The last theory, that pus found in the middle ear is always a case of true otitis, seems to be the most logical.

Prentiss¹¹ has shown that there is a dependent portion of the antrum in an infant, so located that there may be a collection of pus without the possibility of drainage. He also calls our attention to the fact that the aditus, antrum and ossicles are as large in an infant as in an adult. It may be possible that an infection of some long standing might resolve in the tympanum but still be present in the antrum. Prentiss further states that there is a space in the tympanum between the malleus and the incus in an infant which may be closed off from the remaining part of the tympanum so that when a myringotomy is done there still remains pus in the epitympanic space. Dean compares this type of case with that of an attic suppuration in an adult. He explains that although there is pathology found in the attic at operation, the remaining portion of the tympanum may be in fairly good condition.

Lyman¹² of St. Louis says that at birth the mesodermal tissue, which is later absorbed, leaving various folds of mucous membrane, persists in the tympanic cavity in later life. Resorption begins in the lower portion of the cavity, and by the eighth week the lower and middle portions of the tympanum form a distinct cavity, with thick mucous membrane folds persisting. The upper portion of the tympanum, the so-called epitympanic space, is not free from this mucous tissue until the first or second year. Satisfactory drainage will take place if the infection is limited to the lower portion of the tympanum, but not if the epitympanum is invaded.

A group of one hundred cases examined and studied during a period of four years comprises the material for this report. The cases may be classified into two groups: the acute and the chronic. We have intentionally not differentiated between otitis and mastoiditis, but have preferred to group them under otitis media, with or without mastoid involvement. Very little can be said as to the etiology, but a few observations have been made.

1. Infections of the tympanum and mastoid are apparently secondary to infection in the nose and throat. A diagnosis of

paranasal sinus disease was made in all but six cases of this series during the last two years. The prevalence of sinus disease is probably best explained by the variable climate. According to the report of the United States Weather Bureau, the precipitation in Iowa for May, 1926, was 4.64, and the mean average temperature was $+54.6^{\circ}$ with slight daily variations. One case of acute otitis media was seen during this month. The precipitation in January was 1.63, and the average mean temperature was $+24.6^{\circ}$, while in February the precipitation was 1.55 and the average mean temperature 32° . The number of cases of otitis media seen in infants in January was eight and in February eleven. It would appear, according to these figures, that the precipitation has very little to do with the incidence of otitis media, but that the low temperatures and the extreme changes from day to day play an important rôle. This is again shown, because during June, July and August, 1926, we saw only three cases in the three months, whereas in September and October, with the drop in temperature, six were observed.

2. Most of the infants come from the pediatric outpatient department. It is consequently impossible to determine the duration of the infection. Most of the cases were artificially fed. Only four were breast fed. The ages range from eighteen days to fifteen months, the mean age being five months. Two prematures were eighteen days old.

2. Ninety-two had bilateral involvement.

4. Spontaneous rupture of the drum membrane occurred in twelve cases. In eight pus was found in the external canal at the initial examination.

5. The mastoiditis may appear to be primary. Slight pathology of the drumhead, such as redness, lusterlessness without apparent bulging, was present in seven cases. Myringotomy usually revealed no pus or serum in the middle ear. However, on paracentesis of the posterior superior canal wall, which is usually sagging in these cases, pus was found in the mastoid antrum. It was not uncommon, in the presence of slight pathology of the drum membrane, to find a dry tympanum at the time, and within a few hours profuse serous or purulent discharge. It seems the best explanation offered is that, due to the infection, there is a marked swelling of the

tissues of the tympanum. The cavity becomes obliterated, and in time the infection may extend into the mastoid antrum.

6. In the presence of hemolytic streptococcus, hemolytic staphylococcus albus and encapsulated streptococcus the infection is usually the most severe. Cultures of the mastoid antra are taken at the time of operation and from the canal following myringotomy. Those from the canal are of very little value; nearly 75 per cent were reported staphylococcus albus nonhemolytic, 2 per cent were hemolytic staphylococcus, 15 per cent were hemolytic streptococcus, 6 per cent nonhemolytic streptococcus and 2 per cent unidentified bacilli. Those from the mastoid antrum at the time of operation were very much different. Nonhemolytic staphylococcus albus was reported in 10 per cent, hemolytic staphylococcus in 10 per cent, pneumococcus in 5 per cent, hemolytic streptococcus in 45 per cent, nonhemolytic streptococcus in 28 per cent and encapsulated streptococcus in 2 per cent. The virulence of the infection proved greater where hemolytic streptococcus, pneumococcus and encapsulated streptococcus were found. One can not always rely on the type of organisms as an index to the severity of the infection, because in several instances staphylococcus albus was reported in the mastoid cultures, and clinically the infection was of the most virulent type.

Every case in this series was first seen by the pediatricist, most of the cases being seen in consultation on their service. A very close relationship must exist between the pediatricist and the otologist. The heads of the departments, or at least the seniors of the services, must meet often at the bedside to discuss these cases and to arrive at definite conclusions in regard to the proper treatment. An infant may have a bulging drumhead, bulging of the posterior canal wall, and from the otologic standpoint drainage may seem to be the proper procedure. The pediatricist, however, may, after taking other things into consideration, decide that nothing should be done.

The usual clinical picture of acute otitis media is, as a rule, quite definite. The infant is critically ill. The onset is usually sudden. Marked dehydration may take place in a very short period of time. There may have been food refusals for some time. The weight is stationary or there is a definite loss. A case seen at night may have apparently little dehydration, and

the next day there may be a marked loss in weight with the skin loose and dry. Periods of syncope which may prove fatal may appear in the acute, but these appear more often in the subacute cases. The child appears to be in fair condition. The attack is usually short. Marked paleness ensues, the lips are cyanotic and there is difficulty in breathing. There is usually a marked loss in weight over a short period of time. Four hundred grams in weight has been lost during twelve hours. The fever is often high, ranging between 103 and 105 degrees rectally. This is not constant, as several acute cases of this group had only a degree or two of temperature.

Diarrhea is practically always present. The stools vary from eight to twenty daily, and as a result the buttocks become excoriated. The stools are foul, green and slimy. Food refusals are very often recorded on the chart. The infant becomes nauseated and vomiting is common. The leucocyte count varies from 10,000 to 40,000, with a high percentage of polymorphonuclears. Jeans and Floyd⁴ describe an appearance of intoxication characterized by drowsiness or stupor and grayish pallor which come on simultaneously with or following the fever. Feeding is difficult because of loss of appetite.

Plate 1 illustrates a case showing the marked dehydration which may appear.

The experienced otologist has little difficulty in finding definite pathology upon examination of the ears. Proper light, a very small speculum and able assistance are necessary. Often the drumhead will be red and bulging, and there will be little doubt as to the presence of infection in the tympanum. However, in many this "typical" condition is not present. First of all, it must be determined whether or not the tympanic membrane is normal. The luster of the membrane may be gone, it may appear dirty white or gray or without apparent bulging or "parched" or "baked" white, gray or a dirty yellow. The long process may appear shortened. Small blebs may appear on the drum membrane.

It is difficult in very young infants to determine the presence of bulging of the posterior superior wall, due to the dipping of the superior canal wall. Many times the trauma caused by a careless observer may cause the canal wall to appear red-

dened and bulging. It is very important for this reason that the first examination be made by the otologist.

No case of otitis media which did not present either some change in the drumhead or some bulging of the canal wall has been seen in this service. True, in some instances of long duration, resolution may take place in the tympanum and the drumhead may appear normal, but with infection in the mastoid there has always been some bulging of the posterior superior canal wall. Rarely has swelling over the antrum been found in acute mastoiditis. In only two cases of this series, and these in infants over one year of age, were subperiosteal abscesses seen. Spontaneous rupture occurred in one or both drumheads in twelve cases. The otitis was bilateral in all but eight. This was not always true at the first examination, but eventually both ears became involved. More than one examination before coming to any definite conclusion has been necessary in some cases.

The examination of the nose and throat in these acute cases is extremely interesting. A diagnosis of paranasal sinus disease was made in ninety-two cases. Pus was seen in the ethmoid regions. The nasopharynx was invariably reddened, and pus seen on the posterior pharyngeal wall. Although it was taken into consideration that the X-rays of the sinuses in an infant are of doubtful value, due to the difficulty in interpretation, the antra were often found blurred and infections of the antra were present upon aspiration. The adenoids were found infected and bathed in pus in many. The tonsils were often chronically but rarely acutely infected in the older infants. Case 1 illustrates fairly well an acute otitis media with mastoid involvement.

Case 1.—Baby R., aged twelve months, was admitted to the pediatric ward because of malnutrition, and was diagnosed hypothyrepsia. The child had been breast fed for the first few months, but failed to gain when placed on a formula. He began running a septic type of temperature on October 11, 1926, at times reaching as high as 104°, accompanied by rather sudden loss of weight and diarrhea, with from nine to fifteen foul and greenish stools daily. He vomited, refused most of his feedings and had marked dehydration. The general physical and urine examinations were negative. The white blood

count was 29,000. The drumheads were found to be red and bulging, and there was definite bulging of each posterior superior canal wall. Pus was found in each side of the nose, and the posterior pharyngeal wall was reddened and covered with thick grayish pus. Myringotomy was done on each side, and thick white pus under pressure obtained. Following this, he did not do as well as had been expected. There was a continued loss in weight, more marked dehydration and more frequent stools. More adequate drainage seemed advisable, and after consultation with the pediatricist bilateral mastoidectomies were done. Pus under pressure in each mastoid antrum was found, and there was also necrosis of each cortex. Hemolytic streptococcus grew from the cultures taken at the time of operation. The night following the operation the temperature was 104° rectal. The second day there was a definite gain in weight and the temperature gradually decreased. The baby was discharged on November 21, 1926, with a normal temperature, the posterior wounds healed and the canals dry, and had gained 400 grams in one month.

The sinus disease had been routinely treated twice a day with a nasal spray of 3 per cent ephedrin hydrochloride followed in five minutes by 5 per cent argyrol dropped into each side of the nose.

Chart 1 shows the temperature and weight curves for the above case.

Plates 2 and 3 are photomicrographs of tissue taken from this case. Grossly there was little change in the cortical bone. There was no evidence of granulation tissue in the cancellous spaces, but these and the mastoid cells contained puriform material. The microscopic examination showed the bone chalky and it broke easily under the knife when being cut. inflammatory cells of the polymorphonuclear variety were present, and there were no evidences of repair as shown by granulation tissue, bone and fibrous tissue proliferation and sequestration of bone.

Chronic otorrhea in infants is not uncommon. It is unusual to find that the drumheads have ruptured spontaneously in hospital practice. This is probably due to the fact that they are watched more carefully and a myringotomy done when the

occasion presents itself. Many cases are brought in from without, on the other hand, which have ruptured spontaneously.

A few cases of so-called chronic mastoiditis without apparent middle ear infection have been seen during the last year. This indicates that the infection of the tympanum has subsided but was still present in the mastoid.

Jeans,¹² in the fall of 1926, noticed several cases of athrepsia which seemed to be improving very slowly in spite of changes in formulas. At intervals of three days to one week there would be a slight elevation of temperature, usually not higher than 101°, and simultaneously diarrhea would occur. The stools would range from four to six daily, and during these periods occasional food refusals were charted. Instead of the marked loss in weight typical of acute mastoiditis, there was a rather steady gain in weight without dehydration. The urine examination was negative, but there was a very slight elevation of the white count. No satisfactory explanation could be found as to the cause of these symptoms. Jeans felt that some infection of the ears, nose or throat was responsible. A requisition for an examination of the ears, nose and throat was sent. Case 2 illustrates the above description, together with the results of the treatment instituted after consultation.

Case 2.—R. P., aged fourteen months, had an entrance complaint of inability to gain in weight. The baby was breast fed until one year of age and then was put on dryco. Food refusals were frequent, and there were occasional periods of diarrhea. The general physical examination revealed nothing except that the baby was emaciated. It was thought that the youngster had been receiving a fairly rational feeding and that there must be some other cause for the diarrhea, state of nutrition, fever, drowsiness and loss of weight. The infant was seen in the otolaryngologic service on November 19, 1926. Much pus was seen in each ethmoid region. The posterior pharyngeal wall was slightly reddened and the tonsils were large and chronically infected. The anterior cervical glands were just palpable. Both ears revealed reddened drumheads. The posterior canal wall left appeared to be bulging, but the right was questionable. Myringotomy, bilateral, was done but no fluid was obtained. The white blood count at this time was 12,800;

polymorphonuclears 57 per cent. The intradermal test for tuberculosis and the Wassermann reaction were negative. There was a loss of 200 grams in weight on November 20th, with a very slight elevation of temperature. Food was refused and the diarrhea increased to eight stools. It was thought that since the general examination was negative and since there were positive findings in the ear, nose and throat, the infection in the ears or nose must be responsible for the condition. Because of the bulging of the posterior superior canal wall and the reddened drumheads a bilateral mastoidectomy was done on November 21st. The left mastoid antrum was filled with granulation tissue and pus, as were two or three cells in the tip. The same condition was present on the right side, but not to such a marked degree. The following day there was a slight reaction, the temperature going as high as 103° , and only a slight gain in weight. The temperature gradually became normal, the diarrhea ceased and the food refusal disappeared. Plate 4 illustrates the granulation tissue found at the time of operation.

Grossly the bone was hard, and the trabeculae of bone lining the cancellous spaces were prominent. There were bits of granulation tissue plus an occasional small sequestrum. The microscopic examination showed progressive tissue changes with evidence of repair in the presence of an inflammatory process. The inflammatory cells consisted of mononuclears rather than polymorphonuclears.

Chart 2 shows the weight and temperature curves.

Sinus disease may simulate mastoiditis in infants. Jeans and Floyd⁴ have shown that much the same clinical picture may be produced by both. The onset is usually more insidious and the symptoms less pronounced in acute paranasal sinus disease. There is usually an immediate subsidence of the symptoms after drainage in acute otitis media or acute mastoiditis, whereas in acute paranasal sinus disease recovery is more gradual. Jeans⁴ cites a case to illustrate this point: "A patient, '3810,' had been thriving. At the age of one month, without apparent cause, its weight became stationary and then, coincident with the onset of diarrhea, decreased abruptly, the patient losing 450 grams in five days' time. The acute illness

was marked by the appearance of intoxication, the features becoming pinched and the color ashen. Drowsiness and lethargy were marked. Dehydration was such that considerable amounts of fluid were given parenterally in an attempt to prevent death. As many as nineteen stools were observed in a day. At the height of his illness he was found to have acute paranasal sinus disease. Treatment was directed to the sinuses, and from that day the patient's condition improved. The diarrhea became less and finally ceased when free drainage was obtained."

About the same time two cases with very much the same clinical picture died, and at autopsy the findings were negative except for the presence of paranasal sinus disease. The findings were negative in one, except for thick pus in the right maxillary sinus.

Acute mastoiditis may be complicated by acute paranasal sinus disease. Attention is called to this fact, because following myringotomy or mastoidectomy some of our cases failed to respond. The severity of the symptoms would be decreased but they would not disappear until treatment of the sinuses was instituted. This is best illustrated by Case 5.

Baby M., fourteen months of age, on September 11th, became very ill, with high fever and had several convulsions. There were from fifteen to twenty loose, watery stools daily with marked loss in weight, some dehydration and food refusals. A lumbar puncture was done and the fluid was normal. There was a marked nasal discharge. The child appeared to be very drowsy. Little was found on physical examination except that the child was extremely spastic, markedly dehydrated and there was a fine tremor of the hands. The urine and blood Wassermanns were negative. The white count was 22,000, with 80 per cent polymorphonuclears. The otolaryngologist found the nose full of pus, the posterior pharyngeal wall reddened and the faucial tonsils very large and subacutely infected. The right drumhead appeared reddened and the left lusterless, but there was no bulging, with a slight sagging of the posterior superior canal walls. Two days later there was definite bulging of each posterior superior canal wall, and a myringotomy was done on each side. Pus under pressure was obtained from

the left but nothing from the right. Paracentesis of the right posterior superior wall revealed frank pus in the antrum. A bilateral mastoidectomy was done and much pus was found in each antrum. The cells in the tip were broken down, and a few cells over the sinus on each side were filled with pus. The granulations found in each antrum indicated that the infection had probably been present for some time. There was a marked reaction following the operation, the temperature going as high as 105° , with a continued loss in weight. The diarrhea and dehydration, although less, persisted. It was quite evident that there was still some source of infection. The nose was reexamined and again was found to be full of pus. An examination of the sinuses under anesthesia was advised. This was done under chloroform oxygen anesthesia and the report was as follows: "Much pus in each ethmoid region. A very large bunch of infected adenoids was found in the nasopharynx. Thick, ropy pus was aspirated from each maxillary sinus." Through an opening made into each antrum by means of a rasp, the sinuses were washed out with a warm boric solution, and this was followed by a 5 per cent argyrol solution. The child began to gain in weight immediately, the temperature approached normal and the stools were markedly improved. Chart 3 illustrates the temperature and weight curves.

Occasionally cases of faulty feeding clinically simulate mastoiditis. Two cases, four months of age, entered the department of pediatrics in September and October, 1926. They were sent to the hospital on account of failure to gain. Both presented a clinical picture very much like that seen in chronic mastoiditis. Baby B. was put on a proper feeding formula and there was an immediate gain in weight. The diarrhea ceased and the temperature eventually became normal. The other baby failed to respond to a change in formula. A bilateral myringotomy was done because the otolaryngologic report revealed red and bulging drumheads. The temperature gradually became normal, and there was a cessation of the diarrhea and a marked gain in weight. A month later a bilateral mastoidectomy was performed because of the persistence of discharge. Each mastoid antrum was filled with pus and granulations. Chart 4 shows the temperature and weight curves of Baby B., which responded to the change in the feeding formula.

Chart 5 illustrates the temperature and weight curves of the second baby, N. B., whose symptoms subsided with a bilateral myringotomy.

Three babies have been found dead in bed during the last year. All three apparently had been doing well, from the standpoint of the pediatricist, and had not been examined by an otologist. All had a slight elevation of temperature, periods of mild diarrhea, with occasional food refusal but rather constant gain in weight. In pronounced pictures with the usual exaggerated symptoms enumerated, it is easy enough to suspect that the ears are responsible, but it is these obscure cases with apparently mild symptoms that are overlooked. The following case illustrates this point.

Baby C. J., aged three months, was a feeding case, complicated by impetigo, which apparently had been doing well, with steady gains in weight, occasional food refusal and some diarrhea but no dehydration. The infant was seen on rounds at 9 in the morning and appeared pale and anemic. Before noon he was found dead in bed. The white blood count was 12,100. At autopsy nothing was found but an acute bilateral suppurative otitis media, congestion of the brain, kidneys and adrenals. The blood culture was sterile. Chart 6 shows the temperature and weight curves.

The prognosis is dependent upon certain factors:

1. The duration of the infection. The earlier the treatment is instituted, the better the prognosis.

2. The presence of other systemic complications. The prognosis is grave in the presence of septicemia, pneumonia, etc. One case of this series who died was shown at autopsy to have a right lateral sinus thrombosis.

3. The virulence of the organism is a large factor in the recovery of the patient. At various times during the year the infections appear to be unusually severe, and many die in spite of all that one can do. Hemolytic and encapsulated streptococci are prevalent at these times.

The treatment depends largely upon the pediatricist. It is absolutely necessary for the otologist and the pediatricist to work in closest cooperation, and it is wise for them to make rounds together. Once a diagnosis of otitis media or mastoiditis has been made, the treatment depends largely upon the

constitutional symptoms present. Rarely are the otologic findings so outstanding that a myringotomy or mastoidectomy can be unhesitatingly advised. These constitutional disturbances have always been present in the cases comprising this series. A drumhead may appear reddened or bulging, but the pediatrician may be satisfied with the general condition of the patient. Nothing should be done unless there is absolute indication from an otologic standpoint. Conservatism is practiced at all times, especially if complications are present.

A bulging posterior superior wall, which usually indicates involvement of the mastoid, should be preceded by a myringotomy. Repeated myringotomies may be necessary if the opening in the drumhead closes in a short time. Occasionally an infant is in such poor condition that the best possible drainage must be done as quickly as possible. It may be necessary to wait until the pediatrician can get him into as good condition as possible by the administration of fluids, etc.

A myringotomy may be all that will be necessary. Frequently more adequate drainage is necessary, as is shown by the following case. Baby O. R., aged one month, entered the pediatric service because of colds and indigestion. He did not take his feedings well and there was some diarrhea. The skin was loose and dry, and the temperature was 102°. The otolaryngologic examination revealed bulging and reddened drum membranes. Each posterior superior canal wall was sagging. The faucial tonsils were very red and acutely infected. Much pus was present in each side of the nose. Myringotomy was done and pus under pressure found. The temperature dropped to 98.6°, and there was 150 grams increase in weight after the myringotomy. There were four stools daily, occasional food refusal and for five days a slight elevation of temperature. The temperature remained normal for the next four days, followed for five days by a steady gain in weight, four stools daily, occasional food refusal and a slight elevation of temperature. Four days later the temperature reached and remained normal, with a steady gain in weight. Thirteen days after myringotomy, while the baby was taking its feeding, it suddenly gasped and died. The mastoids were then opened and smears and cultures showed hemolytic streptococcus.

No anesthesia is used for myringotomy in infants. The canal is cleansed with alcohol. Some have advised local anesthesia for mastoidectomy, but a general anesthesia of chloroform oxygen is preferred in this department. Harding¹⁴ believes that a deep anesthesia is not necessary. With chloroform oxygen no mucus or saline is secreted, and there is no injury to the respiratory tract. The patient is asleep in two or three minutes and usually awakes at intervals during the operation. There is no gastric disturbance, as the patient is given liquids as soon as he is returned to his room. He is kept in good pink color throughout the operative procedure by the addition of oxygen. The anesthesia is not started until the operator is ready to work, as the patient can be anesthetized while the field of operation is being prepared and will be awake by the time the dressings are applied after the operation is completed.

The infants are immediately transferred back to the pediatric ward following operation. This is necessary in acute cases because the pediatricists are most proficient in administering fluids and supportive treatment. Good nursing and care of the infants are essential. The feedings are, as a rule, very difficult, especially as food refusals are common. Frequently one nurse is necessary for each infant to force the feeding so that the entire amount is taken. Rigid rules of asepsis in going from one patient to another should be observed.

The mastoid operation, once decided upon, should be done completely and rapidly. Five minutes for each side should be the extreme limit. One child of this series, critically ill, was operated upon as rapidly as possible. Despite the intervention, the child died. The autopsy examination revealed one large mastoid cell containing pus. This may not have been the responsible cause, but it illustrates the necessity of a thorough operation.

Paranasal sinus disease is associated with the ear condition in almost every case. The sinuses are, therefore, treated from the beginning. Very conservative methods are first used, such as an ephedrin hydrochloride spray, 2 per cent, followed in five minutes by 5 per cent argyrol to each side of the nose. In some instances, even in babies a few months old, it has been necessary to wash out the maxillary sinuses before the symptoms subsided.

CONCLUSIONS.

1. Otitis media in infants is not infrequent and may produce a syndrome of gastrointestinal disturbances.
2. It is necessary that the otologist and pediatricist work together.
3. Acute otitis media in infants is rarely an otologic problem alone.
4. All of the cases in this series have shown some pathology of the drum membrane or sagging of the posterior superior canal wall.
5. Chronic mastoiditis may occur without apparent evidence of trouble in the middle ear.
6. Paranasal sinus disease may produce the same systemic disturbance as is found in acute otitis media, but to a less degree.
7. Paranasal sinus infection almost invariably coexists with otitis media in infants.
8. In almost every instance the treatment of the otitis media should be managed by the pediatricist.

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Plate 1.

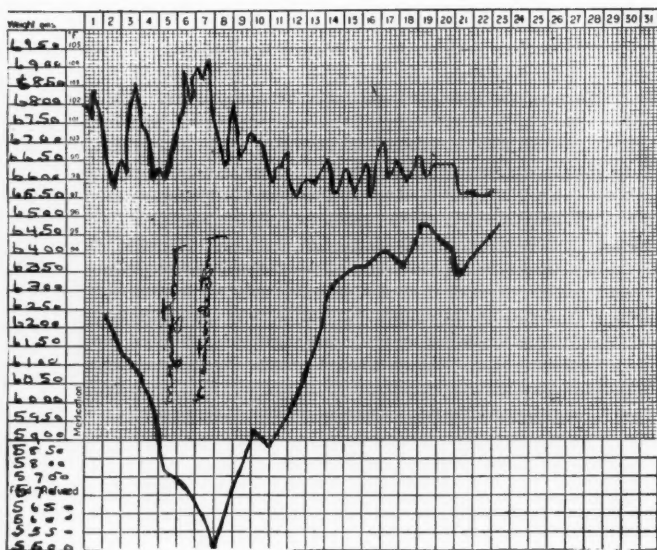


Chart 1. Temperature and weight curves for Case 1.



Plate 2. Ref. No. P-27-3a, O-26-1229. Photomicrograph showing dead bone and inflammatory tissue.

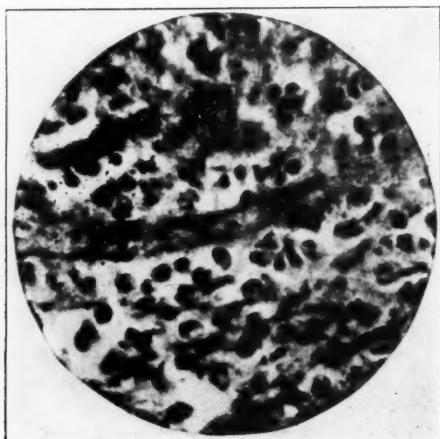


Plate 3. Ref. No. P-27-3b, O-26-1229. Photomicrograph illustrating inflammatory cells and blood vessels.

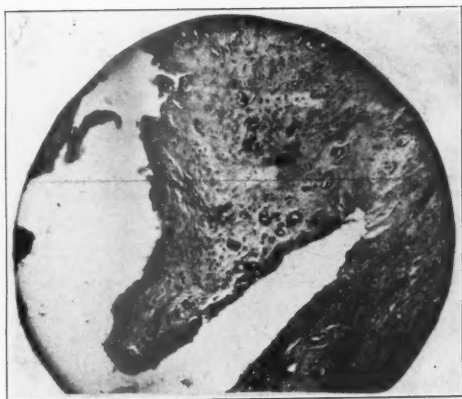


Plate 4. Ref. No. P-27-2, O-26-1467. Illustrates old granulation tissue.

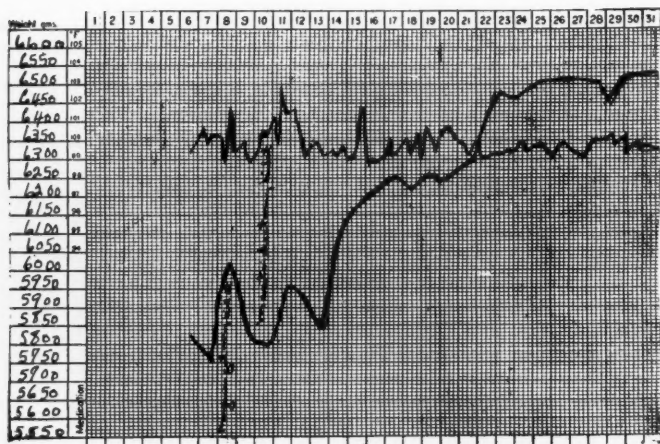


Chart 2. The weight and temperature curves for Case 2.

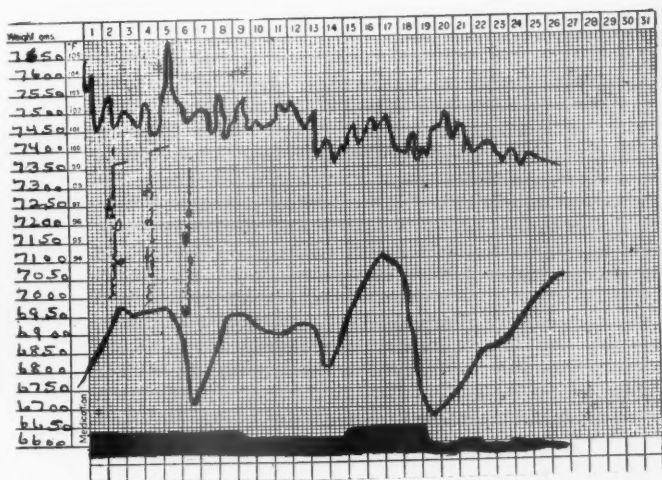


Chart 3. Temperature and weight curves for Case 5.

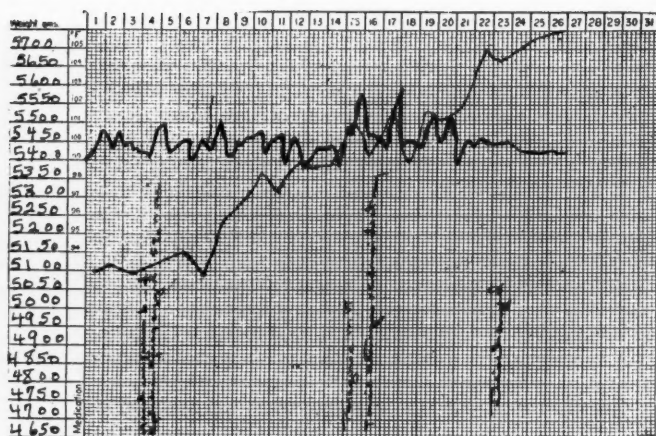


Chart 4. Temperature and weight curves for Baby B.

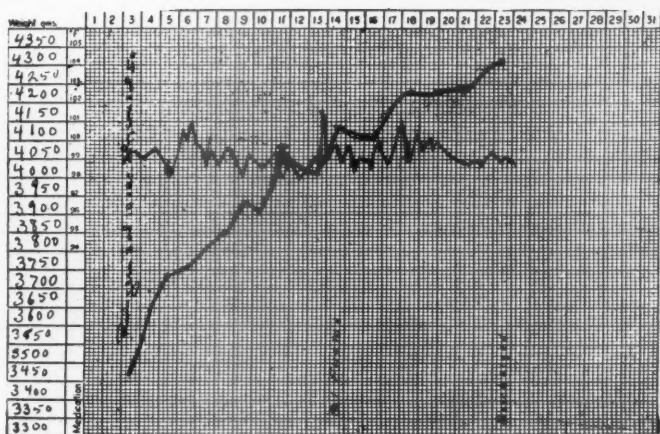


Chart 5. Temperature and weight curves for Baby N. B.

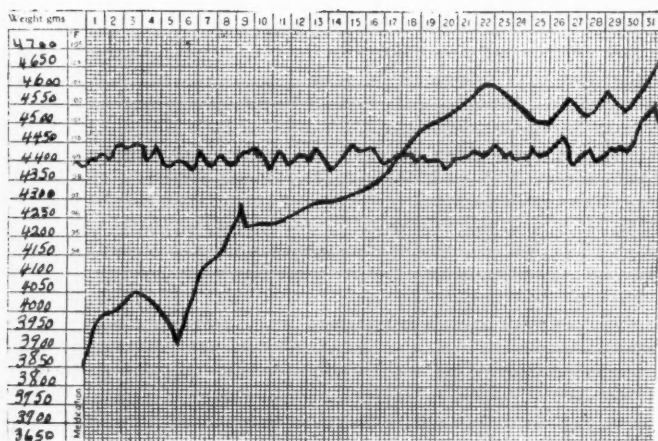


Chart 6. Temperature and weight curves for Baby C. J.

TUBERCULOSIS OF THE MIDDLE EAR, WITH ESPECIAL REFERENCE TO HELIOTHERAPY.

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Any discussion of purulent otitis media necessarily involves some reference to the mastoid, since there is such an intimate relationship between the middle ear and mastoid.

Historical outline: McCart¹ of Edinburgh divides tuberculosis of the middle ear into two groups: (1) Tuberculous otitis media in children under fifteen years of age; (2) tuberculous otitis media in adults. In his series of 55 cases reported, the maximum age incidence was two to five years. There were 46 children under 15 years of age and 9 adults. Logan Turner² reported a series of 51 cases under 15 years and 9 adults. He found the maximum age incidence to be in the first year of life. The preponderance of our cases has been in adults suffering from pulmonary tuberculosis. This probably is due, at least in part, to the large population of tuberculous adults in Colorado.

St. Clair Thompson³ states that among 700 cases seen in three years at King Edward Seventh Sanatorium, only two showed chronic suppurative otitis media which he regarded as tuberculous. Goldsmith⁴ of Toronto, in a survey of 300 cases of pulmonary tuberculosis in the Moskoka Free Hospital for consumptives, found none of the patients suffering from tuberculous otitis media. At Cragmoor Sanatorium, with an average of 100 patients, we ordinarily have from four to six cases of tuberculous otitis media. This corresponds roughly to the incidence at U. S. Naval Hospital, Fort Lyon, Colo., when I was on duty there during the late war.

Route of Infection.—Eustachian tube, blood and lymph stream. J. S. Fraser⁵ has shown by microscopic sections the spread of tuberculous infection along the eustachian tube to the middle ear. A patient recently observed by the author at Cragmor Sanatorium had tuberculosis of the nasopharynx and

a bilateral tuberculous otitis media. This most probably was an infection by way of the tubes, possibly by continuity, as Fraser¹ describes. However, the vast majority show no such lesion, and usually there is no way of determining definitely the route of infection. The form of nourishment in children apparently plays an important rôle in some localities. In McCart's¹ series 75 per cent of the children, whose nourishment was noted, were fed on unboiled cow's milk, and he feels that the infection in children is usually milkborne, the bovine type being present. The author's cases in children have been among those who have been infected by tuberculous mothers.

Clinical Aspects.—As a rule tuberculous otitis media, in adults, begins insidiously, and the first evidence of its presence may be aural discharge. Adults are very apt to have some symptom which makes them think there is something wrong with the ear, but this is often so slight that they fail to mention it until a discharge is noted. Pain is a rare symptom and is seldom, if ever, present unless we are dealing with a mixed infection. Some writers lay a great deal of stress on multiple perforations, but this has been the exception in my cases rather than the rule. Some of these patients have not been seen at the onset and have had a fairly large perforation at the time of first examination. It is possible that these patients had multiple perforations which coalesced. The inflammation of the drum is usually low grade throughout, with very little redness, and the cone of light may occasionally be seen after spontaneous perforation. Usually granulations are to be seen in the middle ear a few weeks after the onset. These have a light pink color in contrast to the more definitely red color seen in the ordinary types of infection. At the onset the discharge is seropurulent and is apt to be scant. Later this becomes somewhat thicker and more frankly purulent. Mastoid tenderness is rare in adults, but may occur in the presence of a mixed infection. The course is apt to be mild and chronic. We see the more acute type in children, and in these patients there is frequently mastoid involvement, associated with a cervical adenitis. Facial paralysis is a fairly common complication. In McCart's¹ series it was present in 17 of the 46 children, but in none of the adults. Spencer² states that it occurs in approximately 50 per cent of the cases. Labyrinthitis and

meningitis occur, but less frequently. I observed an adult case, several years ago, in which there was a tuberculous otitis media and mastoiditis accompanied by a streptococcus infection. There were no symptoms or signs of an intracranial involvement. The mastoid was operated upon and healed after about two months. The wound broke down several times and discharged pus for short intervals. The patient died about two years after the operation, from pulmonary tuberculosis. Autopsy revealed a localized tuberculous meningitis in the mastoid region. The lesion was apparently quiescent. Habermann⁶ has reported a case of ear infection proceeding through the lymph channels from a brain tubercle. This may have been true in the above case.

Diagnosis.—The diagnosis is made from the characteristic onset, the middle ear findings, the chronicity, the presence of an adjacent or remote tuberculous focus, the finding of bacilli in the aural discharge, by smear or guinea pig inoculation, and by pathologic examination of excised tissue. Smears of the pus very rarely show tubercle bacilli. They are more often found in scrapings from the middle ear or mastoid. The finding of giant cells should not be relied on, as they can be found in simple inflammatory tissue. Guinea pig inoculation is very reliable, but at times the pig dies from the mixed infection.

Treatment.—As was mentioned previously, such patients may not be seen until the drum membrane has ruptured. The question, however, arises as to what we should do for patients in whom spontaneous perforation has not occurred. When we are dealing with a pure tuberculous otitis media, we have a process similar to a cold abscess elsewhere in the body. The tendency is to avoid opening tuberculous abscesses unless there is pointing. Where tuberculous otitis media is suspected, it seems better not to open the drum membrane unless rupture threatens, because occasionally such a case will go on to resolution. Such problems confront us rarely, and most tuberculous ears go on to suppuration within a few days to a few weeks. If the discharge is very profuse, irrigations with warm boric solution should be instituted and continued several times daily until the amount becomes scant. Simply wiping out the canal twice daily with a small cotton swab will then suffice. Certain drugs applied locally are of value. I frequently use the follow-

ing prescription: **R** Phenol and tr. iodin $\bar{a}\bar{a}$ M XV, alcohol Z IV, water q. s. ad $\bar{5}$ I. Sig. 3 or 4 drops in ear twice daily. Heliotherapy is of definite value and is worthy of a thorough trial in the chronic cases, except when the pulmonary condition is quite active with a moderate elevation of temperature. In such instances the lung condition is of prime importance and should receive first consideration. It is not our custom to use local or general heliotherapy on febrile cases, and I believe this is the plan followed by most heliotherapists. Complete rest in bed will lower the temperature in a comparatively short time in favorable cases. The patient is then in condition to receive more benefit from heliotherapy with less danger to the pulmonary lesion.

The treatment consists of reflected sunlight by means of a modified solar laryngoscope. This instrument was originally devised for the treatment of laryngeal tuberculosis and is now in general use for that purpose. Many or all of you are familiar with it and I will not attempt a description, but will show some slides illustrating its use. Many others have used direct sunlight and recommend it, but I have seen no reference in the literature to the use of reflected sunlight. There are several advantages to the latter, along with one or two disadvantages which may be mentioned. With a little practice the patient can learn to see the tympanic membrane quite well and can determine whether the sun's rays are reaching the middle ear or are simply shining on the canal wall. By looking in the ear daily he can discover crusting which may be preventing free drainage. Also, he takes a keener and more intelligent interest in his condition because he can see it, watch its progress, and feel that he is doing something definite toward effecting a cure. One disadvantage is that the mirrors do not reflect all the sun's rays. This does not appear to be a serious objection, as those reflected are effective in tuberculous laryngitis. The cost of the instrument is at times a consideration.

The patient is directed to take a half minute exposure once or twice daily and increase a half minute a day up to fifteen or twenty minutes. I have used this method at Cragmor and in Colorado Springs for a little over two years and feel that my results are sufficiently encouraging to warrant its continued use. Cases have been noted that were almost dry in which

heliotherapy had to be discontinued temporarily for one reason or another during a period of ten days or two weeks. Frequently the discharge would increase markedly during this time and decrease a few days after resumption of sunlight. With some patients, progressing favorably, the middle ear became dry without healing of the perforation, and in others there was a complete healing with closure of the perforation.

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Fig. 1.



Fig. 2.



Fig. 3.

CORRECTION OF PRONOUNCED TYPES OF SADDLE NOSE WITH MIXED IMPLANTS OF BONE AND CARTILAGE.

BY LEE COHEN, M. D.,

BALTIMORE.

The most pronounced types of saddle nose invariably have their origin in early childhood, before full size of the nose has been attained. The bony portion, always the more affected, fails to keep pace with the growth and development of the child, while the cartilaginous portion is but little if at all hindered in its growth. This prominence of the fully grown cartilaginous nose, along with the flattened and shortened bony portion below the outstanding frontal eminence, presents a nose grotesque and snubbed in its appearance.

This type of deformity has for a long time been classified as congenital saddle nose, and from time immemorial congenital lues has been looked upon as its cause. While the causal relationship between syphilis and saddle nose in many instances must be acknowledged, cases coming to us for treatment have not infrequently been found to have followed injury in early childhood. Abscesses resulting from such injuries, having been allowed to proceed without care to destruction of septal support, and in many instances with a full or partial loss of the nasal bones, account for many of our pronounced deformities; and the earlier in life such injuries are sustained the more marked is the deformity later.

Some of these cases, where a considerable loss of the nasal bones took place during the suppurative process, with a resultant marked abbreviation in length of the nose, bore such resemblance to the classic luetic deformity, without loss of skin, that, in the absence of all other earmarks of syphilis, we were convinced of the actual absence of syphilis only after several negative blood and spinal fluid Wassermann tests.

This statement should not, however, lead us to minimize the importance of ruling out lues in every case before attempting correction by grafts, since lues if present means, of course, failure in these operations. Luetic patients must first be rendered fit through intensive preliminary antiluetic treatment.

The belief in the relationship between lues and saddle nose, so widespread among the laity, we find causes many subjects coming to us for correction more real mental anguish and embarrassment than the deformity itself.

Shortness of the nose in these pronounced types has been the one insurmountable difficulty in the attainment of perfection, as far as facial symmetry is concerned. The shorter nose naturally causes the upper lip to appear longer, but the resulting improved appearance from an absolutely straight dorsum, following correction, makes this abbreviation much less striking. To lengthen such a nose would necessitate external incisions, for the utilization of the sliding flap method. Being unalterably opposed to external incisions in such rhinoplastic operations, and since our patients have been highly gratified by the results obtained, we are content with the slightly shorter nose.

It is scarcely necessary to mention before this body that the general resisting power of the patient must be up to scratch, and that local purulent conditions within the nose must be excluded before operation is undertaken; also that preparation of the field (technic described in former monographs) must be assiduously carried out.

Source of Graft Employed.—Celluloid, ivory and all sorts of inorganic substances need only be mentioned for condemnation. How one can expect such foreign bodies to remain indefinitely in the human tissues without causing trouble and requiring eventual removal is truly remarkable, and the most experienced operators in this field are fast discarding the use of the inanimate substances.

Aversion to the use of grafts composed solely of cartilage is well known to those familiar with my work. Cartilage can never unite with the underlying bone, and hence always remains a movable body adherent to the overlying skin only, difficult to retain in the proper position and liable to more or

less absorption. Also if the implant is properly narrowed, to obtain a thin dorsum, it is almost certain to spoil our subsequent results by curving toward the perichondrial covered surface.

Grafts from the tibia also failed in our cases to unite with the underlying nasal bones, and after several years disappeared almost entirely through absorption. Furthermore, weakening of the leg with fracture of the tibia from slight trauma, which occurred in two of our cases, should not be minimized when considering its use.

Spine of the scapula has been used with success by Iglauer, in a case recently reported, wherein union with the underlying nasal bone occurred and no absorption of the graft had taken place one year after operation. Whether this graft from the scapula may not later be absorbed only time can tell, and we may look forward with interest to a later report on the subject.

Anatomic resemblance of the rib bone to the nasal bones, experience has proven, makes firm union between them an assured fact, provided always that the graft is firmly held in contact with the underlying nasal bones, by means of a suitable splint, for a period of ten to fourteen days, the apposing surfaces thoroughly freshened and all periosteum removed. Then, with the lower third of the graft composed of costal cartilage, which can be trimmed to any desired thickness or shape, we have the ideal substance for implants.

My own preference, therefore, is a graft taken from the seventh or eighth rib of the right side, just where the bone and cartilage join, so that the length of such graft may consist of about two-thirds bony rib and one-third costal cartilage.

1. The bony rib growing fast to the nasal bones, or, in their absence, to the anterior edge of the bony septum in the center and the anterior edges of the nasal processes of the superior maxilla on each side, has invariably given us excellent results, with no absorption after five years' observation in a number of instances. The graft thus becomes an integral part of the bony framework of the nose.

2. This type of graft places bone in contact with bone, and cartilage where it has always existed. Bony union above permanently prevents mobility of the entire graft, and by this union nourishment is supplied to the lower cartilaginous por-

tion of the implant, reducing the danger of absorption to a minimum.

The advantage of such immovable graft cannot be overestimated, and it is used by us even where no upbuilding of the bony dorsum is required, for example, where a triangular depression exists at the junction of the bony and cartilaginous dorsum, from loss of support after a septal abscess or faulty submucous resection. In these cases only a narrow strip is removed from the center of the outer table of the bony rib, while from the adjacent costal cartilage the section includes its entire thickness; care must be taken here to prevent an over-elevation of the dorsum and effacement of the nasal notch. It is, therefore, necessary to lower the plane of the existing bony dorsum with a rasp, and to make the bony portion of our graft as thin as possible by removing the last vestige of diploic structure from its under surface. Then it is quite a simple matter, with a knife, to trim the cartilaginous end of the graft from its lower surface to any shape required for filling in the depression of the nasal dorsum below. Grafts thus constructed have the same dorsal plane throughout the entire length, so that an even nasal dorsum is always assured.

3. If our grafts are removed subperiosteally, leaving a strip of periosteum and perichondrium attached only along the center of their outer surface, which subsequently becomes the dorsal surface of the implant, there can be no injury to the pleura—the bugaboo emphasized by those opposing use of the rib. Inconvenience to these patients, who are generally able to walk to the washroom by the fourth or fifth day, and who with few exceptions are discharged from the hospital in one week, is certainly not a matter for serious consideration, and I cannot see where grafts removed from other parts of the body can cause much less inconvenience.

We find it most helpful to make a wax model of the nasal depression, from which a dentist may prepare for us a facsimile of metal. This metal model, boiled with the instruments, is used as a guide in shaping of the implant, which we then find almost invariably fits and corrects the dorsal depression with the nicety of a dental inlay filling.

Three cases have been selected from my records to illustrate results obtained.

Case 1.—Miss K. B., age 22. Family history negative. Several negative blood and spinal fluid Wassermann tests excluded presence of lues. Just prior to her tenth year, a fall, injuring the nose, was followed by a septal abscess. A prolonged suppurative process resulted, with loss of practically both nasal bones and much of the nasal septum. I might mention she was never very robust, and that her lowered resisting power doubtless influenced the extent of the destructive process.

In 1920 a general surgeon in a Southern town placed a tibia graft upon the dorsum nasi, but with no success whatever, for on her arrival in Baltimore in 1925, five years later, not a vestige of this implant could be found, and through the skin over her nose the nasal processes and the anterior nasal spine could be distinctly felt. A glance at the photograph prior to operation cannot fail to convince us of the crying need of a plastic correction. Also the patient had for years practically cut herself off from all social activities, and was at all times in a depressed state. After correction of deformity with mixed bone and cartilage implant, pursuing the method just outlined, the improved appearance as seen in the after photograph, taken one month later, resulted. Her friends, from whom I have repeatedly heard, inform me of the great change in her, that she mingles freely with people and takes part in the social life of the community. My photographs, you will note, are but rough prints, without any retouching, but in the second slide is shown a finished picture sent by the patient in April, 1927, two years after operation, from which continued improvement in appearance may be noted and the change in her mental outlook is reflected.

Case 2.—Miss R. B., age 23. Came to us early in October, 1925, both for the removal of tonsils and for the correction of a marked saddle nose. Her nose was not a shortened one as in the preceding case, nor was there a septal perforation or any change within the nose requiring attention. Family history negative, Wassermann negative, and as far as could be ascertained from the history, she had never suffered injury to her nose which might account for this underdevelopment of the nasal bones.

On October 10th, under ether anesthesia, the tonsils were removed. On October 29th, also under general anesthesia, a

mixed bone and cartilage graft was removed from the seventh rib of the right side. After shaping same, by a previously prepared model of the depression, it was placed upon the dorsal surface of the nose, through incisions made from within. The vestibule was packed with iodoform gauze tape, after closing the incisions with black silk sutures, and the copper saddle splint applied. This patient was able to leave the hospital in one week, and for her home in Atlantic City three weeks later, with the result shown by photograph, taken one month after operation. I saw her recently, and the nose looked far better than when this picture was taken.

Case 3.—Mr. W. W. P., age 36, was operated upon in February, 1926, after excluding lues by Wassermann tests, as well as by family history. At the age of four or five years, a fall upon the nose was followed by a septal abscess. For several months he suffered much pain and from a profuse nasal discharge.

No nasal obstruction existed, nor was there present a perforation of the septum. Unlike Case 1, vestiges of both nasal bones were present, but so juvenile in size that the dorsal plane of the nose was almost even with the cheeks. A snap judgment in this case, as well as in Case 1, would impel one to believe lues the primary cause of the deformity, but most careful laboratory tests disproved this.

Correction was made, after carefully prepared models, by placing a mixed graft on the nasal dorsum in the usual manner, and the patient left for his home twenty days later, in excellent physical condition, and with a most gratifying result. He was seen by me seven months later, when his cosmetic results seemed better than ever, and more recent word from him stated that all was still very satisfactory.

1820 EUTAW PLACE.



Case 1.—Before.



Case 1.—After.



Case 1.—Two years later.



Case 2.—Before.



Case 2.—After.



Case 3.—Before.



Case 3.—After.



Case 3.—Before.



Case 3.—After.

LV.

INJECTION OF THE NASAL GANGLION AND COM-
PARISON OF METHODS.*

BY GREENFIELD SLUDER, M. D.,

ST. LOUIS.

In 1908 I advocated the injection of the nasal ganglion with a straight needle under the posterior tip of the middle turbinate. Later, I appreciated the advantages of the curved needle. At that time I realized that the posterior palatine canal was another approach to the ganglion, but I did not consider it as good as the nasal approach. It seemed to me that it was more likely to strike lateral to the ganglion. Later, the posterior palatine canal method was advocated by my friend, Dr. Simon L. Ruskin, and was welcomed by many rhinologists, who thought it was simpler than the nasal approach and more easily performed. I, too, admitted the simplicity of the approach and at once began to try it. I very soon found, however, that the needle, which was supposed to stop automatically on the face of the sphenoid (See Fig. 1) and thereby strike automatically into the ganglion, did not always do so. The needle passed upward and did not stop at any buttress of bone. (See Fig. 2.) I realized that I had passed beyond the level of the ganglion and I withdrew the needle without injecting any fluid. A little later I tried it on the skull that I show you here, to see where the needle went under such circumstances. It is obvious at once that if the needle passes slightly lateral, it enters the orbit through the intraorbital fissure and readily passes into the supraorbital fissure when it meets the third, fourth, fifth and sixth nerves and ophthalmic vein, which at this point is the beginning of the cavernous sinus, and is in very close proximity to the optic canal, where it meets the optic nerve. If the posterior palatine canal is right for the injection, the needle very readily reaches the face of the

*Read before the Middle Section of the American Laryngological, Rhinological and Otological Society, St. Louis, Jan. 31, 1927.

sphenoid. If, however, the canal curves slightly outward, the needle is directed into the intraorbital fissure and into the orbit, and it does not reach the face of the sphenoid at a point corresponding to the nasal ganglion—that is, between the vidian canal internally and the foramen rotundum externally. The same holds true if the posterior palatine canal is of wide caliber. This also permits a deflection of the needle outward.

It may be said that the proper method for utilizing the posterior palatine canal is one of measurement. The needle should not be inserted beyond a certain depth, but inasmuch as the nose varies from two to three inches from floor to roof it is obvious that any point of measurement is inaccurate. Observations have also shown that the length of the canal varies in skulls that seem to be pretty nearly the same.

The method of approach beyond the posterior tip of the middle turbinate has long been before you. I have a drawing here to remind you of it. (Fig. 3.) It, too, is not infallible, as was shown a number of years ago. (Fig. 4.) As is well known, the anatomy varies in practically every nose, and it takes an experienced rhinologist to be at all certain of injecting the ganglion from under the tip of the middle turbinate. (Fig. 5.) All the details of these difficulties were pointed out by me in 1918.* (The method of approach through the sphenopalatine foramen with a curved needle was also outlined in this treatise.) From my extended experience, I believe that the approach through the sphenopalatine foramen is probably less difficult and more trustworthy than from under the tip of the turbinate. Moreover, the bone under the turbinate is very often so hard that it cannot be pierced by the needle used for this purpose. A question may arise, Why not drill a small hole through this bone and reach it in that way? When one recalls, however, that the internal maxillary artery is in intimate association with the ganglion and that the whole pterygomaxillary fossa is small, one hesitates to drill into it.

It has been my experience that bleeding from puncture with the straight needle under the turbinate is very readily controlled by a small pack inserted to the bleeding point by a

*Headaches and Eye Disorders, 1918, St. Louis. The C. V. Mosby Co.

straight applicator. I know of one case, however, in which all methods failed and the carotid had to be ligated. The number of bleedings in my experience have been very few. When bleeding occurs from puncture through the sphenopalatine foramen, it is very much more difficult to control and usually requires a postnasal plug drawn forcefully into place. It is my belief that the rarity of bleeding in injected cases makes the question almost negligible. I believe that any accident through the posterior palatine canal would be fraught with infinitely greater disaster. Ruskin* uses his needle $4\frac{1}{2}$ cm. He advocates $3\frac{1}{2}$ to 4 cm. insertion.

*Laryngoscope, February, 1925, XXXV, 87-108.



Fig. 1 shows the needle in the narrow posterior palatine canal. It arrives automatically upon the face of the sphenoid where the nasal ganglion lies. In this specimen, injection through the posterior palatine canal could not go wrong. The method shown is that advocated by Dr. Ruskin.

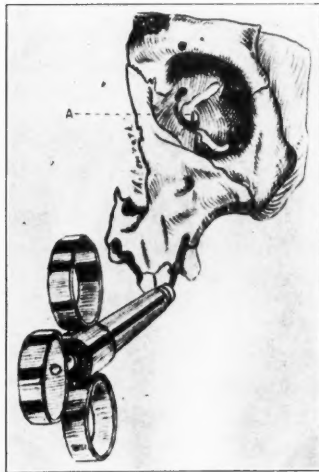


Fig. 2. shows the needle inserted through a wider posterior palatine canal in a specimen in which the pterygoid process was somewhat convexed outward. The tip of the needle is seen in the upper orbital fissure, where it passed the third, fourth, fifth and sixth cranial nerves and the ophthalmic vein which at this point is the beginning of the cavernous sinus. The damage which would be done at this point by the injection of alcohol is obvious.

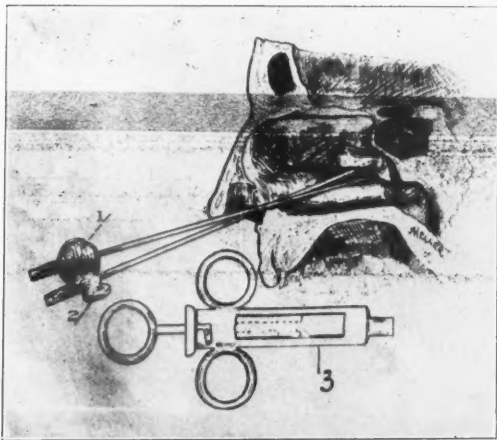


Fig. 3 shows both the straight and curved needles in use. (1) shows the curved needle inserted through the sphenopalatine foramen. (2) shows the straight needle inserted under the tip of the middle turbinate at a distance of $1/3$ cm. (3) shows a nasal and Record syringe which has been found convenient for this purpose.



Fig. 4 shows two needles. (1) needle placed a little bit too high. It shows its entrance into the upper meatus of the nose. (2) needle inserted at the proper point for injecting the nasal ganglion.

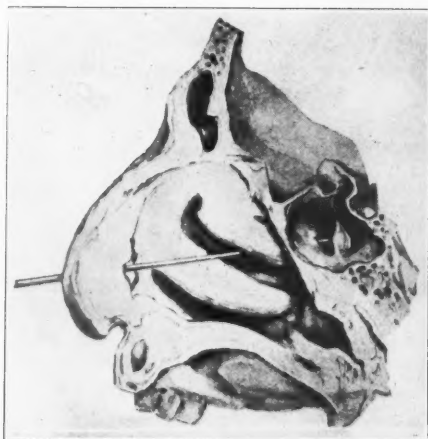


Fig. 5 shows a specimen in which a straight needle has been inserted under the tip of the middle turbinate but has passed a trifle too high. It very quickly passed into the cavity of the sphenoid.

LVI.

THE ROLE OF SURGERY IN THE MODERN X-RAY
TREATMENT OF CANCER IN THE LARYNX.

BY PROFESSOR GEORGES PORTMANN,

BORDEAUX.

The development during recent years of therapy by the X-rays has created new problems for surgeons, and the treatment of cancer of the larynx is a particularly striking example of this. One of the best arguments that the surgeons use for advising the cutting out of the larynx, in the case of intrinsic cancer, is the favorable constitution of this organ, a real cartilaginous box, inside which the neoplasm remains a long time enclosed. The small number of lymphatics connecting the interior of the larynx and the neighboring groups of glands makes the ganglionic invasion tardy and allows the removal with a great chance of success, if the operation is early enough, of the cartilaginous box and its neoplastic contents. The existence of the cartilaginous skeleton, while favorable to the surgeon partisans of total laryngectomy, constitutes, on the other hand, a very serious obstacle for the X-rays. The problem of the treatment of cancer by the radiations consists in sending to the level of the lesions a quantity of rays, tending toward the "epidermic doses" without going beyond this on the surface of the skin, to make a surface "isodose" of the value desired regular and having all the extension necessary. These conditions at the level of the larynx are difficult to reconcile with the integrity of the normal tissues of the neighborhood, for Regaud and most of the French X-ray men have long ago taken as a biologic standard the "epidermic" dose; that is to say, that which is necessary and sufficient for the elective destruction of the normal epiderm (radio épidermite de Nogier-Regaud). They think that the majority of epidermic cancers can no more resist the X-rays than the epidermis from which they come, and that most of them are remarkably less in resistance. Without being able to state exact figures, Regaud and

his collaborators think that the doses of sterilization corresponding to the cancer of the pharynx, for example, are of the class in dimension 70 to 100 for 100 of the "epidermicide" doses. Thus is regulated the rate of rays which one tries to send in the cancerous region. Unhappily, at the level of the larynx the conditions are not favorable for using such high doses. The eccentric position of the organ, the neighborhood of the mucous membrane of the pharynx and the esophagus, the screen which the cartilaginous skeleton constitutes for the rays predisposes to the radionecrosis. The X-rays are there between three breakers, the skin, the mucous membrane of the food and air passages, and the cartilage.

While waiting till new technical improvements draw us near to a rate of 80 to 100 per 100, or till one finds the means of increasing the radiosensibility of the neoplastic tissues, one is reduced, as Regaud says, to compromises between efficiency and risks.

And it is thus that we have been brought to remove the obstacle constituted by the laryngeal cartilages, in order to allow X-ray men a better use of radiations. This intervention, which will consequently precede the radiotherapeutic treatment, will be done in an absolutely aseptic manner—that is to say, in taking care not to open the laryngeal lumen. My operative technic consists in making a partial or total subperichondrial resection of the thyroid and requires the following different steps:

ANESTHESIA.

I always make this intervention under local anesthesia with novocain or butellin, 1 to 200, by three areas of injections placed in the median line at the level of the hyoid bone, in the middle of the thyroid cartilage, in the middle of the cricoid cartilage. One thus infiltrates the superficial cutaneous and muscular layers. Then the needle is pushed till it touches the cartilage and one continues the external subperichondrial injection of each thyroid plate; about ten centicubes are necessary. The patient, with a block placed under his shoulders, has his head in extension in such a manner as to make the larynx protrude.

TECHNIC.

First Step, Incision.—It begins above on the level of the thyroid bone and descends on the median line as far as the cricoid cartilage: section of the subcutaneous connective tissue.

Second Step, Exposure of the Thyroid Cartilage.—The subhyoid muscles are dissected in the median line at the level of the aponeurotic raphe and held on each side by two retractors; thus the anterior part of the thyroid plates is exposed.

Third Step, Detaching of the External Perichondrium.—Incision of the perichondrium at the anterior angle of the thyroid cartilage exactly in the median line; the perichondrium is then separated from the cartilage with the aid of an elevator similar to that which is used by the submucous resection of the septum.

The perichondrium is then held away from the cartilage by a retractor.

Fourth Step, Opening of the Cartilage and Detaching of the Internal Perichondrium.—With a knife a small aperture is made in the anterior part of each thyroid plate. Through this aperture one passes the knife, which separates the internal perichondrium from the cartilaginous lamina.

Fifth Step, Resection of the Cartilage.—Two methods can be given, according as one makes a partial or total resection.

(a) **Partial Resection.**—One takes away with cutting forceps the two thyroid plates, but keeps in front, above, underneath and behind a little band of cartilage, which serves as a frame to the soft tissues of the larynx, prevents their collapse and allows the persistence of the laryngeal lumen.

(b) **Total Resection.**—In this case a tracheotomy has been made previously. The canula is put in place at the level of the second and third rings of the trachea, in order to leave between it and the operative wound one or two centimeters of healthy skin.

One takes away with the cutting forceps all of the thyroid cartilage, taking great care not to open the larynx in detaching the internal perichondrium at the level of the anterior angle of union of the two thyroid plates.

The cartilage completely taken away, the larynx is represented only by a mass of soft tissues without resistance, and

the laryngeal lumen disappears by collapse of the two walls of the organ. The internal perichondrium follows above to the thyrohyoid membrane and underneath to the cricothyroid membrane.

Sixth Step, Suture of the External Perichondrium.—This suture is done with catgut and by separate stitches.

Seventh Step, Suture of the Superficial Layers.—Suture of the subhyoid muscles with catgut and of the skin with horse hairs.

The cicatrization is by first intention, and the patient is sent, eight days after the intervention, to the X-ray man, who begins his treatment.



Fig. 1.

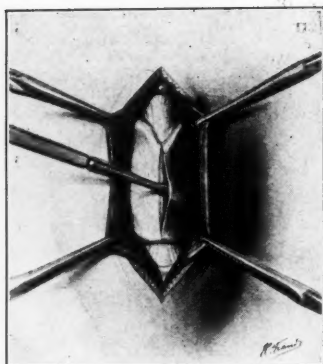


Fig. 2.

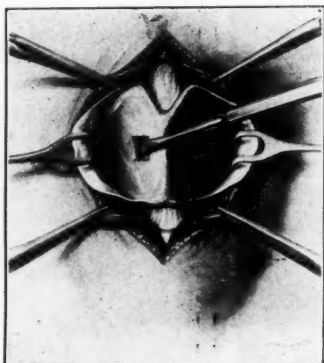


Fig. 3.

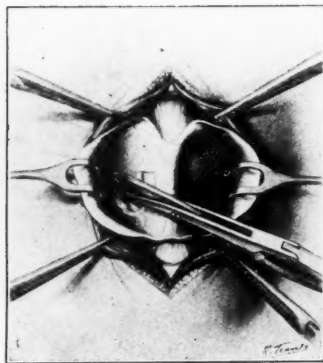


Fig. 4.

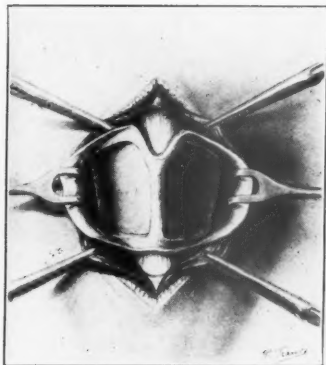


Fig. 5.

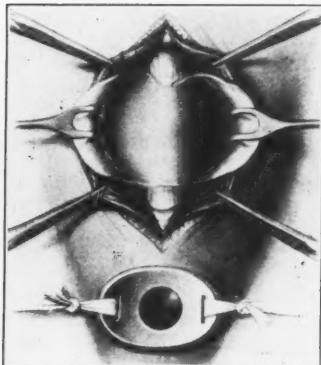


Fig. 6.

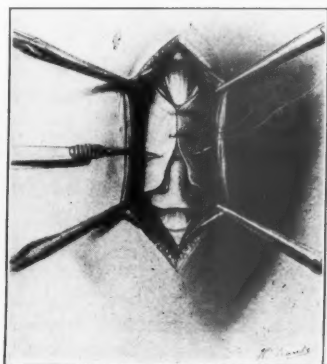


Fig. 7.

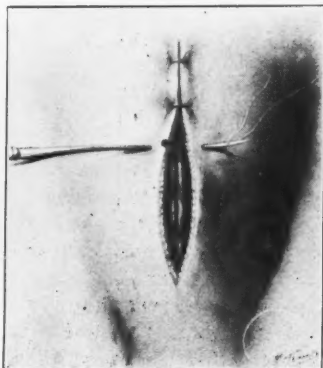


Fig. 8.

LVII.

OSTEITIS DEFORMANS AND THE EYE, EAR, NOSE
AND THROAT SPECIALTIES.*

By SHERWOOD MOORE, M. D.,†

ST. LOUIS.

Paget's disease of the bone, or osteitis deformans, is a much written about condition, so much so that it is almost commonplace. Up to 1918 there were 246 cases reported in the literature, and in 1923 there were listed 287 articles in the Index Medicus dealing with the disease. Since then additional publications have been added, with an increased number of cases. With the widespread use of radiology, evidence is growing that this disease is not as rare as it was formerly supposed to be. The incidence of one case in ten thousand hospital admissions commonly reported is too low. The figure for Barnes Hospital shows a slightly higher frequency than this. Physicians are generally familiar with Paget's disease when it is far advanced. However, the diagnosis of the affection when it is not widespread is not easy, and is frequently impossible unless recourse to X-ray examination is had, as the writer has pointed out in a previous communication.

Paget's may be defined as a disease of the skeletal system, of unknown etiology, which tends to its generalized symmetric involvement. It is characterized by being initiated with a rarefying process, later followed by condensation, the latter following so closely upon the former that the two are nearly always observed side by side. This results in the production of an increased volume of the involved bone. Increase in volume, coupled with a striking and characteristic X-ray appearance unlike that observed in any other condition which affects bone, renders the diagnosis of the disease so certain that the

*Read before the Middle Section of the American Laryngological, Rhinological and Otological Society, St. Louis, January 31, 1927.

†From the Washington University School of Medicine.

combination of the two may be considered as pathognomonic. In no other bone lesion is this found or even approximated. Just as advanced cases of osteitis deformans are recognized at a glance and are generally familiar to the medical profession, so the localized processes are little or incompletely understood. The disease may be confined to a single bone or to a portion of a single bone for such a long period of time that there has arisen the belief that there is a distinct monoosteitic type. Since it may be so localized, and further, since it may have its beginning in any portion of the skeleton, it becomes apparent that confusion may easily arise when bones in certain regions or with special functions are affected. The object of this paper is to deal with some of the obscure phases of the disease that may be produced when localized or partially so. Leri¹ carried on postmortem studies in advanced Paget's disease of the base of the skull, and demonstrated decrease in caliber of the openings carrying the vessels and nerves through it. These changes when they occur, as they will as the disease advances, are naturally potential sources of symptoms referable to any or all of the cranial nerves.

The writer has pointed out that with involvement of the skull, Paget's disease deserves close study by the specialists who are concerned with diseases about the head; for example, the otolaryngologist. Not only may there be involvement of cranial nerves due to narrowing of their canals at the base, but the disease may also affect the bones of special function, temporal, maxillary, e. g. The walls of the paranasal sinuses may be so changed as to simulate inflammatory disease. This is true in respect to the temporal bone. Osteitis deformans involving it may and does produce symptoms which terminate in a condition not to be differentiated clinically from those attending otosclerosis. L. W. Jones of Rochester, N. Y.,² has dealt with this subject in reporting a case. As far as I am aware, there are but three references to a comparable result in the temporal bone, either by compression of the eighth nerve or involvement in the internal auditory apparatus.

An example of sudden deafness supervening in a case of unsuspected generalized osteitis deformans of the skull (Fig. 1) was brought under my observation through the kindness

of Dr. Oscar Zink, who made the diagnosis at St. Luke's Hospital.

The writer has had the good fortune to observe two obscure cases with symptoms referable to the sinuses. The first of these has previously been reported.³ This patient had an obstructed nasal cavity, the symptoms of a chronic maxillary sinusitis, and trigeminal neuralgia. Removal of the Gasserian ganglion effected only partial relief. Further X-ray studies revealed the fact that there were extensive changes and enlargement of the bones of the face on the affected side. Along with this was an alveolar overgrowth with partial extrusion of the teeth. The other case was referred from the nose and throat department of the Washington University Dispensary, for films of the sinuses. The maxillary sinus on one side was completely obscured. There was a lack of definition of all its outlines and those of the bones of the face on the affected side. (Fig. 2.) The lateral film gave a clew as to the nature of this change, a part of the squamous portion of the frontal bone showing in the film, this presenting the characteristic appearance of Paget's disease. (Fig. 3.) Investigation elsewhere revealed a fairly widespread involvement throughout the remainder of the skeleton.

Blindness from compression of the optic nerve in its canal has been observed frequently.

Because of the specialized nature of the bones of the head and face, and the presence of the cranial nerves, obscure disturbance of any of their functions should give rise to the question in mind of the attending physician, "Is this or could this case be one of osteitis deformans?" As to the spinal nerves, those subject to osteitis deformans occasionally complain of paresthesias of all types, though the majority never show anything of this nature. Those with pain do not seem to be greatly disturbed thereby. Motor affections seem never to occur, or at any rate have never been reported.

CONCLUSIONS.

1. Osteitis deformans is much more prevalent than is commonly taught.

2. Its manifestations are protean.
3. Atypical cases in the field of the eye, ear, nose and throat specialists should be approached with the possibility of osteitis deformans being the source of the disturbance.

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Fig. 1.

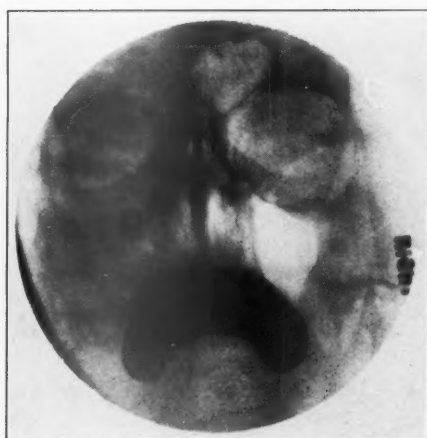


Fig. 2.



Fig. 3.

LVIII.

THE DIFFERENTIAL DIAGNOSIS BETWEEN SEPTIC MENINGITIS, BRAIN ABSCESS AND LATERAL SINUS THROMBOSIS COMPLICATING MASTOIDITIS.

BY GEORGE W. SWIFT, M. D.,

SEATTLE.

Otologists are frequently confronted with the problem of a differential diagnosis between brain abscess, lateral sinus thrombosis and meningitis complicating a mastoid operation.

The following history illustrates the problems that are not uncommon in mastoid work:

Case 28931, Providence Hospital.—Admitted to the hospital April 24, 1926, one week after she had developed an acute otitis media of the left ear, followed by an acute purulent mastoiditis; operation on the 24th by Dr. Klemptner. The operative record shows that at the time she had a blood count of 12,200, 85 per cent polys, negative Wassermann, and at the time of operation streptococcus organisms were found, both in the scrapings from the mastoid and from cultures. I was called on the 12th of May, approximately three weeks following the operation, and found at that time that she had developed a marked rigidity of the neck, headache, vomiting and temperature; the fundus of both eyes showed a marked congestion, but there was a negative Kernig; no nystagmus; 2 plus clonus, both right and left. On the 13th her condition was worse; she had developed a left sided papillitis; the rigidity of the neck was more severe, and headache and vomiting persisted; blood calcium 13 milligrams; a negative blood culture. The case presented the following possibilities: a septic meningitis, a direct extension from the mastoid into the middle fossa; a cerebellar abscess or middle fossa abscess. At the time of operation the sinus had been exposed and found to be normal. An exploratory intracranial operation was considered imperative.

Under general anesthetic, on the evening of the 13th, a lumbar puncture was done; the pressure in the prone position was approximately 20 mm., but the fluid was clouded, almost milk white. The diagnosis of meningitis with a hopeless outlook seemed apparent. However, the mastoid wound was reopened and the bone removed from under the middle fossa, the dura opened and a trochar used for exploring the anterior tip of the temporosphenoid, also the posterior; there was no pus found or evidence of septic meningitis. No exploration was made of the cerebellar fossa because of the cloudiness of the fluid and the absence of nystagmus, plus the presence of a left sided papillitis. The patient was sent to bed and given mercurochrome, 15 cc. of 1 per cent solution, intravenously; this was repeated on three subsequent occasions. The patient made an uneventful recovery. The spinal fluid test showed a negative culture for organisms; 75 milligrams of sugar and many pus cells, too many to count.

Contrast this case with that of Patient 28746, 14 years of age, who was admitted to Providence Hospital, under the care of Dr. Chase, on August 12, 1926. She gave a history of having had a left otitis media when a child, and in May, 1926, four months prior to her admission, she had had an acute attack of the left ear. The records showed that on examination there was a perforation of the ear drum; that she had vomiting, but no nystagmus or dizziness; a left sided headache and all of the reflexes increased. Dr. Wanamaker was called in consultation, and Dr. Chase performed a mastoid operation on August 13. The blood count was 12,900, 80 per cent polyps. On the 14th she complained of pain over the left eye and began vomiting, and on the 15th she had a convulsion, which lasted for three minutes. I was called in consultation on the 16th, and the examination at that time showed the left optic disc to have a filling defect; no nystagmus; no facial paralysis; no rigidity of the neck; a left ankle clonus, but a negative Kernig; pain in the region of the left eye. Headache and vomiting with the beginning papillitis suggested a Gradenigo's syndrome, or, in other words, a serous meningitis as a result of the operation. The girl was very tall and thin, and had been extremely nervous for the past two or three years. The convulsions had not been observed except

by the nurse, and perhaps not sufficient importance was attached to the first one. For the next few days she improved, and on the 19th, six days after the first convulsion, the blood count had dropped to 9,000, but the headache continued. It was decided to do a spinal puncture; the pressure was approximately 18 mm. of mercury in the prone position; the fluid clear; no organisms found. A diagnosis of serous meningitis was made. On the 23rd she had three very severe convulsions and became unconscious; neither eye at this time had developed a papillitis, but there seemed to be a little congestion of the vessels of both discs. She was examined by Dr. Chase, Dr. Webber and myself, but we could not tell whether there was any difference on one side or not, but there was, however, a divergence of both eyes and the patient was in coma.

We decided that there must be an abscess, either of the temporosphenoid or frontal lobe, as the pain had always been immediately behind the left eye. Without any anesthetic an opening was made in front and above the ear, the dura incised and a needle inserted. Slightly tinged, amber colored fluid was found well forward in the region of the anterior horn of the left ventricle. An opening was made behind and above the left ear, the dura incised and a needle dropped backward and downward where resistance was felt. After forcible pressure this was recognized as the tentorium and no effort was made to puncture. The X-rays which had been taken prior to this were of the mastoid region only. The following day the patient was in much better condition; she had regained consciousness, was free of headache and she was taken to the X-ray room, where a stereolateral was taken and showed an extremely large sella. This prompted the diagnosis of a possible cyst, springing from the pituitary and extending forward. She made a nice recovery and was discharged from the hospital on the 10th of September in good condition, free of headache, eyes normal and no evidence of pressure over the two areas where the bone had been removed; the ear had entirely healed.

On the 15th of September she was readmitted to the hospital for study, from the 15th to the 22nd of September, and then went to her home, where she remained until October 13th.

when she was returned to the hospital in a comatose state. Both defects in the bone were now bulging; she had a double choked disc, and spinal puncture showed streptococcus in the fluid. She died on the 14th of October, and the autopsy revealed an enormous abscess in the left occipital lobe; it was adherent to the dura over the tentorium and at the posterior pole, so that when the brain was removed in the usual manner the abscess and its thick wall remained in the skull with the dura. The needle had punctured the wall of the abscess, but had not perforated it. Subsequent to the intracranial operation the patient complained of a left sided hemianopsia; this was falsely interpreted as pressure against the optic radiations. The diagnosis in this case was at no time in doubt, but the localization was impossible. Perhaps had we used air we would have localized the abscess, but we were not permitted to do so.

These two cases illustrate clearly the problems that confront the mastoid operator.

In a series of 800 cases of mastoiditis, operated upon in the Leeds Infirmary, during a year and a half, and reported by Munby and Jowett in the *B. M. J.*, July, 1926, the incidence of complications was 147, or 18.1 per cent. This means that in this series practically one case in every six operated upon for mastoiditis had one or more complications of a serious nature, such as brain abscess, meningitis or lateral sinus thrombosis. During the year 1926, in six of the hospitals of Seattle, 123 mastoid operations were done, with twelve complications. In the Leeds series, brain abscess occurred in 8.9 per cent of all cases; lateral sinus thrombosis in 5 per cent; meningitis, purulent, in 2.5 per cent, while in the Seattle hospitals 10 per cent were lateral sinus thrombosis and the others less than 1 per cent each.

There are certain symptoms which are invariably found present in intracranial lesions; other symptoms are found in some and not in others. I have made some charts for the purpose of showing the differential diagnosis.

CHART I.

MENINGITIS	ABSCESS	LATERAL SINUS THROMBOSIS
MENTALITY		
Semi- or Unconscious	Normal—Mildly con- fused	Normal
HEADACHE		
Type—Constant	Intermittent	Constant
Location—Basilar	May be localized over abscess	Cerebellar
Course—Progressively worse	Varies, mild to severe	No great variation
TEMPERATURE		
Gradually increases	Intermittent or ab- sent—May be sub- normal or normal	Remittent
NAUSEA AND VOMITING		
Not constant symptom	Projectile	Usually after food

CHART II.

MENINGITIS	ABSCESS	LATERAL SINUS THROMBOSIS
EYES		
PUPILS		
Pupils equally dilated	May be dilated side of lesion	No change
DISCS		
No change until late	Unilateral or bilat- eral choked disc or normal	Unilateral engorge- ment or choking
DEVIATION		
Not constant	Convergence may oc- cur on side of lesion	Convergence or di- vergence
RIGIDITY		
"Poker" spine (Opisthotonos)	May be absent	Neck only
PULSE		
Rapid	40 to 60 per minute	May be normal or slightly accelerated
NEUROLOGIC		
Clonus 2 plus, Bilateral Babinski, Dermographia	Unilateral signs	Absent findings

CHART III.

MENINGITIS	ABSCESS	LATERAL SINUS THROMBOSIS
BLOOD		
LEUCOCYTES 10,000 to 15,000	Seldom above 10,000	15,000 to 25,000
SPINAL FLUID		
PRESSURE 10 to 30 mm., prone position	As high as 80 mm., prone position	Normal or not above 12 prone
CHARACTER		
Clouded	Clear or clouded	Clear
NONNE		
Plus	Plus or minus	Minus
SUGAR		
Decreased or even absent	Normal	Normal
CELL COUNT		
High—Polys	10 to 20 large lymph.	Normal
ORGANISMS		
Plus	Minus	Minus
QUECKENSTEDT		
Modified minus	Negative	Positive

CHART IV.

MENINGITIS	ABSCESS	LATERAL SINUS THROMBOSIS
CONSTANT SIGNS OR SYMPTOMS		
Unconsciousness plus.	Crying or braying	Septic temperature. Posi-
Rigidity neck plus.	plus. Projectile	tive modified Quecken-
Kernig plus. Spinal	vomiting plus.	stedt or filling of oppo-
fluid findings.	Choked disc plus.	site disc. Veins on jugu-
	Increased spinal	lar pressure plus. Leuco-
	fluid pressure with	cytosis plus. Normal
	intermissions.	spinal fluid pressure.

CONCLUSIONS.

1. Intracranial complications occur in practically one of every six cases of operated mastoids.
2. Headache, nausea, vomiting and temperature, with some disturbed mentality should prompt the surgeon to consider an intracranial lesion.
3. An exploratory craniotomy is not in itself a dangerous procedure and should be resorted to in doubtful cases.
4. Meningitis may accompany brain abscess or lateral sinus thrombosis and mask the symptoms of these two lesions.

REFERENCE.

Profant: Laryngoscope, February, 1924.

LIX.

CASE REPORT: LATERAL SINUS THROMBOSIS
WITH DELAYED METASTASIS.*

BY RALPH A. FENTON, M. D.,

PORTLAND, ORE.

Cases in which frank metastasis occurs following delayed jugular ligation are unhappily common enough so that most otologists have seen the consequences, endocardial lesions, suppurating joints, lung emboli and all the rest. Metastasis of relatively benign course is perhaps commoner than we realize, especially in those cases in which an occlusive thrombus is not present. Discussion of the protective mechanism in such cases will, I hope, be provoked by this brief presentation.

E. C., a wiry little girl of nine, who had had many previous annoyances from large tonsils and adenoids, was ducked into a school swimming tank about six months ago (October 23, 1926). Next day her nose and eyes were running and her ears felt "stuffy." Two days later she cried with pain in both ears, and on the third morning both drums were found bulging, the left red. Free flow of serosanguineous fluid followed left myringotomy. Temperature reached 100.6, and remained high. The right drum, though always paler, was incised the fourth day. Temperature remained above 100°; the child's color became ashen, although pain had passed after opening both drums. Radiographs showed very indistinct cell structure in both mastoids. White cells were 28,200, of which 80 per cent were polymorphonuclear.

On the fifth day after the original swimming tank episode, therefore, an extensive simple mastoid was done on the left side; time, eleven minutes; dichloramin dressing. The sinus was widely uncovered; it was bathed in bloody pus where the tip cells had broken down, but the wall was smooth and normal in appearance. The bone was decidedly pneumatic; all cells were obliterated as far as possible to follow them. Tem-

*Read before the Western Section, American Laryngological, Rhinological and Otological Society, Portland, Ore., April 1, 1927.

perature ran from 105 preoperative to 100.4 degrees an hour later; there had been slight chilling while the fever was highest. The right ear continued to drain freely.

That night the temperature went to 104.6°, but fell to normal by noon. The child became markedly cyanotic and went into a chill lasting fifteen minutes. The white count had fallen to 8,500. Resistance was very low; the chill was followed by fever of 105.6°, pulse 158, respirations 48. Blood culture at this and all other times taken was negative.

Next day, the seventh, she felt very well in the morning, with normal temperature. Our diagnosis of a mural thrombosis was enforced by another slight chill and cyanotic attack near noon. At 1:30 p. m., temperature 102.8°, the right mastoid was opened (nine minutes), finding generalized breaking down of a pneumatic process, not so far advanced as the left had been two days before. Immediate double ligation and severing of the left jugular was done (twelve minutes); no macroscopic clot was seen. The sinus was then further exposed toward the bulb and the torcular, plugged above, split, cleaned out, plugged below (seven minutes). Slight roughness of the wall near the tip cells was the only evidence of thrombus. Rather free bleeding from the petrosal occurred before the lower pack went in. From the blood and pus of the mastoid a highly hemolytic short chain streptococcus was isolated.

Thereafter, barring considerable nervous irritability, recovery was swift, 101.8° on the ninth day being the highest post-operative temperature. Excessive pain in the left mastoid wound was complained of, which is not surprising in view of the massive resection practiced. About the sixteenth day the temperature, theretofore not exceeding 99.6°, rose to 100°. Lying in bed, the child complained of her calves aching; the urine was negative, and no acidosis was present, according to Dr. Gourdeau, the attending pediatricist. There was no special local tenderness in the legs when alcohol rubbing was done. She walked on the eighteen day, eleven days after the jugular resection; and went home on the twenty-first day. Her white count climbed back to 10,000 the day after the resection.

For four days the little girl was brought to the office for dressings, when it was noticed that she limped a little. Strip-

ping down the short sock and its constricting rubber garter, the left calf was found distinctly swollen, reddened and tender over the gastrocnemius.

On the twenty-seventh day after the swimming tank episode, twenty days after the jugular resection, Dr. Paul Rockey incised the leg under gas, securing about 20 cc. of thick yellow pus. Culture was negative on the media used; in the smears, nothing was seen but polymorphonuclears. Temperature during nine days in bed with the leg elevated ranged from 97 to 99 per cent; white cells on dismissal were 8,500.

Uneventful though slow healing of the vast left postaural breach was complete by the tenth week; the right mastoid healed by the third week, as did the jugular wound.

QUESTIONS.

Was the cyanosis accompanying the chills evidence of showers of emboli?

When did localization of the leg embolus occur?

Was its latent course made manifest by getting the child up out of bed for office dressings?

What brought about the disappearance of bacteria from the leg abscess?

Answers to such questions may contribute a little toward the explanation of the occasional postmortem finding of healed, obliterated thromboses of the jugular; of healed scars of ancient emboli in the parenchymatous organs; of transitory cardiac murmurs during a stormy mastoid convalescence. We are prone to lose sight of the tremendous protective power inherent in the leucocytes of so-called pus. No one hears nowadays of the opsonic index; yet if it be invoked, we will still find certain cases with a high index of phagocytic action which will fight through the heaviest odds and get well. Again, we give small doses of killed bacterial toxin to promote antibody formation. May it not perhaps be possible that the jugular tie operates partly by autohemolysis, partly by a temporary passive congestion upon the circulatory outflow of that half of the brain, to increase the concentration of protective substances in the remainder of the blood?

806 MEDICAL ARTS BLDG.

BRAIN ABSCESS OF OTITIC ORIGIN.*

BY FREDERICK EMERSON HASTY, M. D.,

NASHVILLE.

In the consideration of all cases of suspected brain abscess resulting from middle ear infection, the question of diagnosis is the one most important phase. There is perhaps no one sign or symptom that can in all instances be relied upon as an absolute indication of brain abscess of otitic origin. The diagnosis, therefore, resolves itself into a process of elimination. Conservatism is the one safest rule; on the other hand, neglect and lack of surgical courage are inexcusable. Every otologist has observed patients who presented many evidences of brain abscess which, without intervention, recovered in due time. In the presence of a diseased mastoid, an intradural exploration of the temporal or cerebellar lobes is likely to spread the infection.

The importance of thoroughly removing the pathology in a diseased mastoid cannot be overstressed. In case the dura seems to be involved, it is perhaps safer to work around the edge of the diseased area rather than force curets and rongeurs over the protruding dura to the inner edge of the diseased bone. A rather weak adhesion of the meninges one to another may be holding the infected process within its bounds. It is advisable, in the majority of instances of mastoid diseases where brain involvement is suspected at the time of mastoidectomy, to clear the dura of diseased bone and await developments.

It seems to me that in recent years otologists have been inclined to shift the burden of diagnosis of suspected brain involvement resulting from mastoid disease to the neurologist and neurologic surgeon. If the otologist will keep in mind his positive and suggestive findings of pathology at the time

*Read before the Southern Section of the American Rhinological, Laryngological and Otological Society, at Memphis, Tenn., February 1, 1927.

of mastoidectomy, he may be able to form a more intelligent opinion of the case than would be possible for one to do who had not had a definite knowledge of the pathology in the mastoid. In consultation work we are constantly confronted with this general situation: a complication has arisen, the attending surgeon states that a complete mastoidectomy has been done, the signs and symptoms may be suggestive of brain abscess—in fact, would be quite suggestive if one could be sure that all diseased bone had been removed during the mastoidectomy. All too often, if one will insist upon opening and exploring the mastoid cavity, he will be surprised at the amount of pathology that has been left, and also at the promptness of the patient's improvement after the diseased bone has been removed.

Every case of brain abscess of otitic origin that I have seen recover had at the time of mastoidectomy a complete removal of all diseased bone, and the abscess was opened and drained at a subsequent operation. In this group I do not include subdural abscess. I must confess that my mortality has been high. I have not been able to locate the abscess in some cases except at postmortem.

It should be remembered that in the early stages, at least, an abscess of the brain is a destructive process, and that the intracranial pressure is not likely to be much disturbed. All suspected cases of brain abscess should be hospitalized. Temperature, pulse, respiration, spinal fluid, blood and blood pressure should be observed very closely, and any variation in either should be followed by a more careful and frequent observation. The reflexes should be examined at least once in each twenty-four hours. The surgeon should hold an open mind, should collect every evidence possible, and should keep this tabulated in systematic form. Careful observation will frequently clear up a situation that would be puzzling on one examination. Headache is one of the most common symptoms, but I cannot say that I have been able to detect a definite type of headache that can always be referred to brain abscess. Some cases of serous meningitis, pachymeningitis or extradural abscess will cause headache quite as severe as one ever encounters in real abscess of the brain.

The following cases have been selected to illustrate some of the points mentioned above:

L. C., age $3\frac{1}{2}$ years, had measles. One week later, otitis media in the left ear. The membrane ruptured spontaneously and was not opened by the attending physician. Temperature and discharge decreased and the patient was thought to be quite well by the end of the third week. By the end of the seventh week the patient developed convulsions—more than thirty in twenty-four hours. An aphasia developed, temperature reached 104. Patient seemed semicomatose, the convulsions were epileptiform in type and distinctly more marked on the right side. There was partial paralysis in the right limbs. A mastoidectomy was done under general anesthesia. The cells were filled with granulations throughout, but there was no free pus. There was some serum in the region of the antrum. The inner plate was intact throughout, and on a very careful examination in a clean field, there was no evidence of necrosis. The operation was done cautiously but rapidly, the patient was returned to bed in good condition, and we felt some misgivings for not exploring the temporosphenoidal lobe. Within twenty-four hours the temperature was practically normal and there was no evidence of paralysis. Patient was able to talk but continued to have some aphasia for two or three days. I think this was a case of serous meningitis simulating abscess of the left temporosphenoidal lobe.

M. H., age 7, had a severe cold and complained of earache. The mother was not very much impressed with the slight complaint, and it seemed that the cold had about cleared up at the end of the third week, when the child was found in a convulsion from which she recovered with partial consciousness and with some weakness of the arm and leg on the left side. Two consultations with internists failed to detect the trouble. The third consultant found the right ear drum to be red, indurated, but not bulging. At operation little pathology was found except in the region of the antrum, where a quantity of liquid pus under pressure was evacuated. The bone in the hypertympanic region was destroyed. I approached the diseased area by starting one-half inch posterior to the known pathology and with a rongeur carefully worked around the exposed dura. The dura was kept clear of blood and showed very definite evidence of subdural abscess. A crucial incision

was made and a dram of pus was evacuated. The wound was left open. Dakin's solution was used frequently, and within twenty-four hours the patient was conscious, with no evidence of paralysis. Considerable brain tissue sloughed away; but the physical condition improved until the fourth week of the illness when the patient developed a cold, then pneumonia, and promptly expired. I think that it would have been an easy matter to have torn loose the meningeal adhesions in this case by forcing instruments between the bone and the protruding dura.

J. T., aged 16, chronic mastoiditis for several years. Three weeks previously had a mastoidectomy by another surgeon, but the symptoms of intracranial involvement which were the basis of the original operation improved little, if any. Temperature ranged from 94 to 96, pulse rate from 40 to 55, and the respiration was at times considerably embarrassed. Spinal fluid was reported to contain 750 cells to the cc., but no bacteria were recovered. There was no definite change in the eyegrounds but disturbance in the coordination of the opposite side. Patient was in a stupor practically all the time and complained of most excruciating headache when conscious. On exploration of the mastoid region, there was found an extradural abscess leading by a stem or stalk between the lateral sinus and middle fossa and extending to the lateral surface of the cerebellum. Large pockets of pus were found. The bone was removed one-half inch beyond the diseased dura. This method really circumscribed one large piece of skull. Within six hours after operation the temperature was 99, respiration normal and the patient was conscious. Complete recovery with no herniation of the brain. This case simulated cerebellar abscess.

Mrs. C. E. B., age 68, wife of a physician, complained of more or less constant drainage from both ears since an attack of scarlet fever at the age of two years. For six months profuse drainage from right ear, more or less constant, rightsided headache of frontal type. Sedatives used for several days at a time to get rest. Lost considerable weight and had intermittent disturbance in the function of the face and tongue.

Temperature varied from normal to 100. Operation: Cholesteatomatous degeneration had exposed the anterior surface of

the lateral sinus from the knee to the bulb. The middle fossa was completely exposed, the dura of the middle fossa was thickened, partially covered with granulations, and seemed taut. We really expected to drain a temporosphenoidal lobe abscess within a few days. All signs and symptoms cleared up within seventy-two hours, and there was an uneventful recovery. This case seemed suggestive of abscess in the temporal lobe.

Miss E. J., age 25. Discharge from right ear twenty-three years following an attack of scarlet fever. Pain over right frontal region for one year. Reflexes present and active. White blood count 15,000, temperature 101, respiration 24. Operation: Cholesteatomatous degeneration had destroyed the bone on the anterior wall of the lateral sinus from the knee to near the tip, exposed practically all the dura of the middle fossa and outlined the semicircular canals. Dura in the middle fossa was covered over with granulations and seemed taut. There was considerable destruction about the mouth of the eustachian tube. All of the skin flap was turned toward the lower end of the wound, leaving the dura of the middle fossa uncovered. First day: Patient comfortable, no evidence of facial paralysis. Temperature 101, white blood count 13,000. Third day: 11 A. M.: Patient seemed to be in somewhat of a stupor and with greatest difficulty was aroused. She had developed incontinence of urine and feces. Nerveheads only slightly blurred and faintly white. Abdominal reflexes absent. Knee jerks present but only slightly active. Kernig negative on both sides. Blood pressure 126/85, white blood count 16,000. Temperature and pulse very irregular during the last two hours.

Second operation: 9:00 P. M. A vertical temporal incision three inches long, under local anesthesia. Trephine in the skull. Immediately on lifting the dura of the middle fossa, thick, yellowish, foul pus escaped. Bone rongueured downward to the floor of the middle fossa and backward almost to opening in bone made at previous mastoid operation. Mastoid wound was entered and the exposed dura separated toward middle fossa where pus escaped and a sinuslike opening was found which communicated subdurally with an abscess. A Mosher drain tunnel was inserted with tip projecting into

the subdural cavity above mentioned. Wounds closed with interrupted silkworm gut. Fourth day: Since the last operation patient in a stupor. Still incontinence of urine and feces. Temperature around 102. Involuntary twitching of left deltoid muscle. Right leg somewhat flaccid. Seventh day: Temperature ranged around 102. Blood pressure still showed slight fluctuation. Mental condition somewhat improved. Less elevation in temperature. Wound draining thick, creamy pus. Ninth day: Practically full control of sphincters. Wound still draining slight amount of pus. Eleventh day: Patient seemed to be gradually passing into a deeper stupor. Wound still draining freely, white blood count 12,000. Eighteenth day: Patient still quite stuporous. Distinct weakness of left arm and left face. It seemed that the abscess was not draining adequately, or that there possibly existed more than one abscess cavity. Twenty-second day: Temperature 105. Patient less alert mentally. Mouth pulling to right side of face. Pus draining from temporal wound freely. Twenty-fourth day: No satisfactory explanation of rise in temperature. Patient is normal mentally. Twenty-fifth day. Temperature 98. Forty-second day: Mosher drain tube removed. All wounds healed. This was a case of chronic adjacent abscess treated in a conservative way. Headache was the outstanding symptom.

CONCLUSION.

While it may seem tragic for one to allow a patient to die of brain abscess without locating the trouble, it should be remembered that an exploration of the brain through the mastoid wound is almost sure to result in meningitis if the operative field is not already protected by well established adhesions. On the other hand, an exploration of the temporo-sphenoidal lobe or the cerebellum through a new field that is supposed to be sterile is likely to result in meningitis, regardless of whether the abscess is located or not. In other words, I have a very wholesome respect for the intradural exploration of the brain in the presence of mastoid disease, but for very good reason only would I advise such procedure.

MEDICAL ARTS BUILDING.

LXI.

ACUTE MASTOIDITIS WITH COMPLICATING
FACIAL PARALYSIS; RECOVERY AFTER
OPERATION.*

BY ADOLPH GREENSTEIN, M. D.,

NEW YORK.

This case is not reported on account of its rarity but rather to bring home to the otologist once more the fact that facial paralysis occurs as a complication in acute mastoiditis.

There is no need, at this time, to go into the details of the causes of facial paralysis; suffice it to say that it can occur due to extension of inflammation along the course of the facial nerve, whether in the facial canal, in the internal auditory meatus, or as a result of bone destruction within the mastoid itself.

The degree of facial paralysis varies, depending upon the extent of the inflammation, whether the entire nerve or only certain bundles in the nerve are affected.

While the paralysis may be caused by lesions of the nerve located centrally, during its course through the fallopian canal, or peripherally, it is desired in this report to consider it only in its connection with an acute mastoiditis.

D. C., age 9 years. Two days after surf bathing, on July 30, 1924, patient complained of pain in right ear, slight cough and fever; after several hot ear irrigations the pain subsided.

A week later, on September 7, 1924, I was called in to see the patient. She again complained of pain in the right ear. A right sided facial paralysis was noted, involving the upper branches of the facial nerve. There was no loss of sense of taste. Temperature was 101° F.

On physical examination, a bulging drum was found, dark red in color, with all the landmarks and light reflex gone.

*Read before the Otologic Section of the Academy of Medicine May, 1926. From the Oto-Laryngologic Service of the Beth David Hospital, New York.

There was no headache, vertigo or nystagmus. Myringotomy was performed.

The next day the patient still complained of pain in the ear; there was only a small amount of purulent discharge, although the tympanic membrane was widely opened. She complained at this time of some tenderness over the mastoid tip but not over the antrum. Hearing in the right ear was somewhat reduced but did not lateralize.

X-ray examination showed clouding of the mastoid along the posterior wall and tip.

Blood examination: White cells, 14,000, with 73 per cent polys.

Examination of the ear on this day showed some sagging of the postsuperior canal wall.

In view of the fact that this patient had a facial paralysis, although the mastoid symptoms were not marked, it was deemed advisable to perform a mastoid operation.

On September 9, 1924, the usual mastoid operation was performed. The cells were broken down and filled with a large amount of thick, greenish, purulent material. The sinus wall was diseased and the sinus, on being exposed, appeared normal; aqueductus fallopii also appeared normal. The wound was packed and dressing applied.

A few days after the operation, the facial paralysis began to show signs of improvement, so that on September 18, 1924, the patient was able to wrinkle her forehead and partly close the eye. The middle ear became dry by the third week and the mastoid wound healed in five weeks, during which time the paralysis continually improved, and when discharged had completely disappeared.

In differentiating this condition from other causes of facial paralysis, the most important one is the idiopathic Bell's palsy. In view of the fact that this paralysis began to improve immediately after the mastoid operation, it is only fair to assume that necrosis of the mastoid bone was the cause of the facial paralysis in this case.

800 WEST END AVENUE.

LXII.

PEDIATRIC ASPECTS OF OTOLARYNGOLOGY.*

BY MCKIM MARRIOTT, M. D.,

ST. LOUIS.

In recent years we have come to realize that many important conditions in infants and children are primarily the result of infectious processes in the ears, nose, throat and accessory sinuses, and that treatment of these conditions can only be successful if the infections in question are first cleared up. For many years it has been recognized that the tonsils and adenoids are often the seat of chronic infections and these have been removed in a wholesale manner, often on very slight evidence. The net results have, however, often been disappointing, as the symptoms have persisted. We now know that many of the symptoms which have been attributed to infections in the tonsils and adenoids are, in reality, due to infections in the nasal accessory sinuses, and that in many of these cases the infections can be discovered only after a most careful search. The obvious symptoms of pain, headache and purulent nasal discharge are not necessarily present. Infections of the mastoid, accompanied by fever, local pain and edema, redness and swelling, have been readily diagnosed and radically treated, but it has not been recognized that mastoid infections may occur in young infants and lead to none of the classical symptoms and signs of mastoid disease. Some of the types of infections mentioned are present in a very large proportion of patients that are brought to the pediatrician for treatment, and pediatric practice has become virtually impossible except with the closest cooperation with the otolaryngologist.

During infancy, the chief problem of the pediatrician is that of nutrition. Fortunately, we now have a clear idea as to the nutritional requirements and digestive capacity of the infant and have learned that all of the requirements may readily be

*Read before the Middle Section of the American Laryngological, Rhinological and Otological Society, St. Louis, Mo., Jan. 31, 1927.

met by simple foods, and, most important of all, we have learned that if an infant has been taking a suitable food in adequate amounts and is failing to thrive or has developed gastrointestinal symptoms, the food is not at fault and does not need to be altered. Instead, we look for infection. The infection in question may be in the gastrointestinal tract or anywhere else in the body. It is more likely to be in the ears, nose and throat than elsewhere. Otitis media is the most frequent infection responsible for nutritional disturbances. A frank otitis media with a red, bulging drum is readily recognized, but in many instances the drum is neither red nor bulging, and changes are so slight that they can be detected only by means of the electric otoscope. There may be merely a lack of luster and transparency of the drum. Paracentesis in such cases may give rise to only the slightest amount of discharge, yet improvement in the infant's general condition promptly occurs, irrespective of any change in the character of the feeding. It is particularly in the case of extremely malnourished or athreptic infants that these slight changes in the drum are seen. Other infants develop severe watery diarrhea, of the cholera infantum type, become gray, desiccated and prostrated and vomit much of the food given. Some of these show marked middle ear changes, and pus is obtained on paracentesis. In some instances recovery follows simple paracentesis, but in others, despite the fact that the drum membrane is kept open, the symptoms persist. It is in these cases that the infection has involved the mastoid antrum and has led to a swelling of the mucosa, blocking off the antrum from the remainder of the tympanic cavity, so that drainage of the middle ear fails to drain the antrum. When this occurs, the otologic evidence is a swelling or sag of the posterior superior canal wall, just external to the tympanic membrane. In most instances there is neither redness, swelling nor tenderness over the mastoid. Dean and his associates were the first in this country to draw attention to this type of mastoid infection and to emphasize its importance in the causation of the gastrointestinal symptoms in infancy. Occasionally an opening made through the sag in the canal wall brings about sufficient drainage, but in the majority of instances it is necessary to resort to postauricular drainage, or antrotomy. This simple operation, performed

under local anesthesia, establishes adequate drainage and is, in the majority of instances, followed by extraordinary improvement in the general nutritional condition of these infants. Where the antrum infection has caused the symptoms, diarrhea and vomiting promptly cease and the infant makes a rapid recovery. In most instances it is advisable to do postauricular drainage on both sides, for bilateral infection is the rule.

The decision to perform antrotomy rests upon pediatric as well as otologic considerations. The general symptoms depend upon the nature of the infecting organism, rather than on its location. The hemolytic streptococcus or colon bacillus is likely to give rise to the severe symptoms of diarrhea, vomiting and desiccation. Other organisms may lead merely to a state of poor nutrition and failure to gain, lack of appetite and only occasional vomiting. There may be only a slight elevation of temperature. The leucocyte count, however, is always above normal. Before opening the antrum one should rule out all other possible sources of infection or other causes of the general symptoms. It is also necessary that there be some otologic signs, though these need not be marked. Within the past year we have found mastoid antrum infections, either at operation or at autopsy, in over 75 per cent of all cases of severe nutritional and gastrointestinal disturbances coming to our clinic. The regularity with which improvement has followed the operation of postauricular drainage has served to convince us that mastoid antrum infections are responsible for the conditions mentioned and not merely secondary occurrences.

It is during infancy that walled off antrum infections are especially likely to occur, because of the anatomic considerations involved. Infections of the nasal accessory sinuses can also occur, even in young infants, as certain of these sinuses are developed at birth. Infection of the maxillary antra can bring about the same symptoms in infancy as infections of the mastoid, and this fact should not be overlooked in searching for the causes of nutritional disturbances.

In children beyond the age of infancy, sinus infections are frequent and give rise to a wide variety of symptoms. One of the most frequent general manifestations of chronic sinus

infection in children is a picture simulating that of tuberculosis. The child is pale, languid, has slight evening temperature and often a chronic cough. There is a lack of appetite and a failure to gain in weight, or an actual loss. X-ray of the chest may reveal an enlarged hilus shadow and peribronchial thickening, often extending well out into the parenchyma of both lungs. Small dense areas, such as are usually interpreted as shadows of calcified glands, may be seen. In these cases, tuberculosis is ruled out by properly controlled intradermal tuberculin tests. Successful treatment of the paranasal sinus infection in these cases results in marked and progressive improvement. Chronic bronchitis, at times leading to bronchiectasis, is a fairly common manifestation of chronic sinus infection during childhood. Other symptoms which we have often observed associated with chronic sinus infections have been repeated attacks of abdominal pain, often accompanied by vomiting. In some of these patients the symptoms have been so suggestive of appendicitis that the abdomen has been opened. The vomiting attacks, occurring periodically, are often diagnosed as cyclic vomiting. When sinus infection is found and treated the attacks cease.

Asthmatic symptoms are observed in some children suffering from chronic sinus infection. When the asthma is due to definite sensitization, there occurs a hypertrophic condition of the nasal mucosa, which is said to predispose to sinus infection. In other instances, however, the sinus infection is apparently the original cause of the asthmatic symptoms.

Children with chronic sinus infections, especially those who are also malnourished, are likely to develop heart murmurs and a certain degree of cardiac dilatation. The erroneous diagnosis of organic heart disease is often made on these patients, but the disappearance of the murmurs and the return of the heart to normal size following the removal of infection and subsequent improvement in the general nutrition speak against the possibility of valvular endocarditis. On the other hand, sinus infections are usually observed in patients having true rheumatic endocarditis and other rheumatic manifestations of chorea and articular rheumatism. In our experience, the clearing up of sinus infections has been more effective in

preventing the recurrence of endocarditis, chorea and rheumatism than has the mere removal of tonsils and adenoids.

The association of chronic arthritis with focal infection is, of course, well recognized. We have seen striking examples of the relationship of chronic sinus infection to arthritic symptoms.

One of the most important and clear cut manifestations of infections in the nose and throat is nephritis. The two common forms of nephritis occurring during childhood, for example, tubular nephritis, or "nephrosis," and glomerular, or hemorrhagic nephritis, have, in our experience, invariably been associated with infection. The infection has been found more frequently in the nose and throat than elsewhere in the body. The characteristics of tubular nephritis, or nephrosis, are the passage of scanty amounts of urine containing much albumin and numerous casts, but no blood, a normal sulphonephthalein output, no retention of nonprotein nitrogen and no elevation in the blood pressure, marked generalized edema and severe anemia. In practically all cases of nephrosis in children we have found an infection in the paranasal sinuses, particularly in the maxillary antra. The most frequent organism has been a hemolytic staphylococcus. The effect of suitable treatment of these sinus infections has been very remarkable in these cases of nephrosis. Thus we have seen a young child lose as much as fifteen pounds of fluid within five days' time following the drainage of infected sinuses. When it is possible to clear up the sinus infections, complete disappearance of albumin in the urine is the rule. Reinfection of the sinuses may, however, cause a return of all the symptoms. We have examined a number of the patients at intervals for several years after treatment of the sinuses, and have found no remaining evidence of nephrosis. Unfortunately, it is not always possible to completely eradicate the infection, but this is the only method of treatment which is calculated to bring about more than temporary and symptomatic improvement, and such improvement occurs irrespective of dietary regulation, restriction of fluid, sweating, purging or the use of diuretics. Infections which have persisted for a long while are likely to lead to permanent changes in the kidney. Under such circumstances the most that can be expected from treatment is to prevent further damage or progressive changes.

Hemorrhagic, or glomerular, nephritis is usually if not always the result of streptococcus infection. The most common causes of such nephritis are streptococcal infections of the nose and throat, including the scarlatinal infections. In glomerular nephritis, in distinction to nephrosis, there is blood in the urine at some stage, retention of nonprotein nitrogen, and, in cases of long standing, some degree of hypertension. There are also changes in the capillaries throughout the body. In the majority of instances hemorrhagic nephritis is of short duration and clears spontaneously. If, however, the infection persists for a considerable time, permanent damage to the capillaries of the kidney and systemic circulation may occur. In this way the chronic nephritis of adult life develops. Streptococcus infections in the nose and throat had best not be treated radically at the start, but after the acute stage has subsided all possible means of eradication of the infection should be resorted to.

The conditions so far mentioned are those of fairly common occurrence. Occasionally certain bizarre symptoms, referable to sinus infection, are observed. Thus we have seen patients whose symptoms simulated epidemic encephalitis, associated with paralysis. We have observed children whose symptoms were indistinguishable from idiopathic epilepsy in whom the manifestations have ceased following successful treatment of the sinus infection.

The diagnosis of sinus infection in general must be made by the internist or pediatricist rather than by the otolaryngologist. It is he who first sees the patient, and unless he recognizes the general symptoms indicative of sinus infection, the otolaryngologist will not be called. One important manifestation of sinus infection is readily recognizable by the pediatrician, and that is enlarged cervical glands of the posterior chain. There are relatively few conditions besides sinus and ear infections which lead to enlargement of these glands. Infections of the scalp and leukemia which are capable of causing enlargement of these glands are conditions which are readily recognized. Given a child with some of the characteristic symptoms of sinus infection already enumerated, and in whom enlarged posterior cervical glands are found, one may be practically cer-

tain that sinus infections are present. The diagnosis of the individual sinus involved is the problem of the otolaryngologist, but, due to the fact that the importance of sinus infection in children has not, until recently, been sufficiently realized, consultations with otolaryngologists have often been unsatisfactory. Unfortunately, the average otolaryngologist has centered his attention on tonsils and adenoids to such an extent as to practically ignore the sinuses, and it is in the field of sinus disease that the otolaryngologist can render the greatest help to the pediatrician in the treatment of a large proportion of the patients who come under his care.

LXIII.

FRONTAL SINUS EMPYEMA IN YOUNG CHILDREN, WITH SEVERAL CASE REPORTS.*

BY IRVING MARTIN LUPTON, M. D., F. A. C. S.,

PORTLAND, ORE.

It is more or less the consensus of opinion that frontal sinuses of sufficient size to be considered as a surgical entity, occurring in young children, are an exception to the rule, and are not commonly found. This is true, but nevertheless we must not allow this fact to overrule our judgment, and discard the possibility because of its more or less rare occurrence.

Hajek¹ states that the development of the frontal sinus does not begin until the first year of life, and it reaches the size of a bean at the sixth to seventh year of life. It does not reach its permanent size until the complete development of the body.

Davis² states that as an average the frontal sinus is about 3.8 mm. above the nasion at three years of age, and an advancement occurs of about 1.5 mm. a year until the fifteenth year. This would appear at variance with the radiographic findings in which so many absent frontal sinuses are recorded. Considering the small amount of space involved, it is possible that a frontal sinus may be confused with and charted as an ethmoid cell, thereby increasing the number of frontal sinuses tabulated as absent.³ Radiographic findings are an interpretation of shadows, while on the other hand the measurements are actual findings.

According to good authorities, the frontal sinus has a clinical significance at the age of five. Killian reports operation on the frontal sinus of a child fifteen months old. E. Meyers reports operation on a child three and one-half years of age. Dean states that the anatomic knowledge of the average size which any sinus should have at a certain age is not important, considering the fact that there may be a precocious develop-

*Read before the Pacific Coast Oto-Ophthalmological Society at Spokane, Washington, June 6, 1927.

ment of any sinus so that it might be a surgical sinus much sooner than one would expect.

We have in our experience been surprised by the fact that in the routine study of radiographs of young children a marked disparity exists between the actual findings and the prevalent belief that the frontals do not exist at this early age; or, may I say, are not of sufficient size to be considered as an entity of surgical importance.

In several instances, much to our dismay, this attitude has dominated or influenced our diagnosis, and the possibility of frontal sinus disease has been discarded as most improbable and eliminated as a factor to be considered in the diagnosis of the little patient.

In many cases seen a diagnosis is made of abscess within the confines of the orbital cavity, most likely as a result of an extension of active disease in the ethmoid cells. We have in several instances incised what was supposed to have been such a condition and have ended by opening one or both frontal sinuses, which were of great size, containing thick mucosa, polypoid in character, with the sinus literally filled with pus. This was despite the fact that the radiographic findings were more or less indefinite as to the presence of an actual empyema. There is also that type of case in which frontal sinusitis has been unrecognized and a fistula may have resulted simulating a dacryocystitis. It is logical to assume that in time past many so-called cases of ethmoid empyema with orbital extension have in reality been complicated by severe frontal involvement with all its attendant dangers.

Confusion necessarily must arise when a dense shadow over the frontal region may be due to so many conditions, among which I might enumerate sinusitis and empyema, a shallow cavity or thickened lining membrane, periostitis, luetic bone or osteomyelitis, or an absence of a sinus. Often the presence of a hard, solid edema overlying the sinus and filling the upper portion of the orbital cavity may confuse sharp detail outline, giving rise to doubt regarding involvement. A shadow shown in the shallow frontal or the thickened plate of bone over the sinus in many instances is very suggestive of a pathologic involvement.* Any condition affecting the anterior sinus wall, such as a periostitis, osteomyelitis, luetic or tuberculous

involvement, will of course simulate sinus disease. To differentiate it is necessary to have a lateral view.

A study has been made of many radiographs on file at the Doernbecher Memorial Hospital for Children, at the Shriners' Hospital for Crippled Children and in private collections, not only our own but those of several of our colleagues. In approximately 11 per cent of over two hundred films picked at random, the frontals were easily distinguished and were of greater size than generally conceded for the age of the child. Not a few of them approached adult dimensions.

According to Skillern,⁵ the frontal sinus embryologically is merely an offshoot from the ethmoid labyrinth. In the disarticulated frontal bone, the frontal sinus appears merely as a cavity divided by a septum. The ethmoid closes in these apertures from below, thereby forming the floor of the frontal sinus. It will be seen that the floor of the frontal sinus is in reality a portion of the ethmoid capsule. This fact may explain why frontal infection is easily possible when an overdeveloped sinus is found. It also probably explains why infection is so easily extended upward secondary to acute ethmoid involvements, due to the incomplete evolution of the anterior ethmoid cell into the frontal sinus proper.

The anterior wall of the frontal sinus is composed of cancellated bone and varies in thickness from one-sixteenth of an inch upwards. The posterior wall is thinner, rarely exceeding one-sixteenth of an inch in thickness, even in the adult. This structure forms part of the wall of the anterior cranial fossa and is in contact with the frontal lobe of the brain. Defects in these walls have been found. On account of the thin posterior wall, such possible defects must be considered in relation to inflammatory processes. This same condition has long been known in regard to involvement of the mastoid in children without apparent otitis media, and has received special consideration from pediatricians and otologists in the last few years.⁶

It seems probable, as pointed out by Oppenheimer,⁷ that many cases of meningitis are the result of some unrecognized inflammatory condition of some of the sinuses, notably the frontals and sphenoids. The bony walls of the sinuses in chil-

dren are much softer and more cartilaginous than found in the adult. The mucosa in children is in more intimate relation with the osseous tissue, so that slight inflammation of the mucosa must often produce some pathologic change in the bony walls of the sinus. The lymphatic and vascular systems show a more profuse development in children than is found in the adult.

From our own records we have selected three rather typical cases illustrating the various points in the question, the rapidity of involvement and the attendant dangerous possibilities.

Case 1.—Acute left ethmoiditis; orbital cellulitis; double frontal sinusitis; external radical frontal and ethmoid operation; exposure of dura; recovery. A. H., white boy, 11, robust, admitted to Multnomah Hospital December, 1921. This boy had been suffering from pains in his face and over his eyes following diving during the preceding summer. He had been sick for two months, and a swelling over the left eye had been opened by a neighbor, four months before admission. Yellow streptococcic pus discharged from the fistula since. Temperature was 97.8, pulse 74, white count 9,500. Radiograph showed dark left frontal, with no apparent right frontal involvement.

Radical external left ethmoid operation December 15, 1921. There was little posterior involvement, but a rather large left frontal, placed almost horizontally, with no extension upward into the frontal bone, was found to communicate directly with the right frontal. The partition between was loose, coming away as a sequestrum. An area of dura 1 by 2 cm. was exposed above the left frontal.

Postoperative temperature ran from 97 to normal. There was no diplopia, and the boy left the hospital nine days postoperative and has been well since his discharge from office care a few weeks later.

Case 2.—Right ethmoiditis; orbital cellulitis; right frontal sinusitis with meningeal extension; external radical ethmoid and frontal operation; immediate recovery with subsequent death from other causes. C. K., white boy, 11, admitted to Portland Ear, Nose and Throat Hospital, September 24, 1924.

Following severe head cold, developed severe pain in region of right eye. During course of next few days pain became generalized over head, accompanied by septic type tem-

perature, chills and sweats. Convulsion occurred on day admitted to hospital. Pain became localized over region of right frontal sinus. W. B. C. 22,000. Right nasal passage filled with pus. There was a definite orbital cellulitis present. Patient restless. Radiographs revealed dark right ethmoid and frontal sinuses. The right frontal appeared to be of great size. Left frontal small and clear.

External ethmoid and frontal operation performed. The right frontal sinus approached adult size, measuring approximately $3\frac{1}{2}$ cm. in its lateral diameter and extending upward into the frontal bone $2\frac{1}{2}$ cm. It also encroached over to the left of the midline. The dura over the right frontal lobe was exposed during the operation, and there existed a localized meningitis with epidural abscess formation. Extension and perforation occurred through the lamina papyracea, explaining the orbital involvement.

Postoperative progress complicated by septic pneumonia, endocarditis and an acute hemorrhagic nephritis. Patient left hospital in four weeks with temperature normal and wound closed. Absolute rest was carried out at home for the following month and patient up part time. The renal complication, however, persisted and death occurred five months postoperative. Autopsy refused. Hemolytic streptococci culture.

Case 3.—Right acute ethmoiditis; orbital cellulitis; bilateral frontal sinusitis; external ethmoid and frontal operation; recovery. A. C., white boy, admitted to Portland Eye, Ear, Nose and Throat Hospital October 14, 1926.

Several days following swimming and diving lesson he developed severe head cold. Several days later an edematous mass appeared in the midline of the forehead directly above the nasion. Severe frontal headache was complained of at this time. Moderate temperature. The attending surgeon incised the mass but obtained no pus. Relief from headache was, however, obtained for one day, with reappearance of violent headache. The headache increased in severity for 48 hours, then suddenly disappeared, and the child was apparently well, other than the swollen forehead. Within 24 hours, however, the headache again appeared, to remain for one day, and with its cessation complete inability to breathe through the nose, which heretofore had not been complained of.

At this time we were called in to see the case, and the findings were those of septal abscess with complete nasal obstruction. Temperature 101; W. B. C. 20,000. An edematous mass presented in midline of forehead, size of half an orange.

Radiographs showed dark right ethmoid and frontal. The left frontal sinus did not appear to be involved to any great extent. A dark shadow extended down the midline of the nose corresponding to the line of the nasal septum.

External right ethmoid operation performed. The ethmoid was filled with pus. The right frontal sinus measured 2 cm. in its lateral diameter and $2\frac{1}{2}$ cm. from the floor to its greatest height. A perforation had occurred through the anterior wall of the right frontal connecting with a large subperiosteal abscess. A perforation had also occurred through the floor of the right frontal into the orbital cavity. The partition between the right and left frontal was partially destroyed, and the left frontal, though small, was filled with pus. Pus had also burrowed down along either side of the septum, lifting the mucoperiosteal covering from the bony cartilaginous nasal septum, ballooning them out and causing a complete nasal obstruction. Free incision was made through the anterior nasal opening into the most dependent portion of this septal extension.

Postoperative temperature ran from 103 to normal. Patient left hospital in ten days and has been well since discharge from office treatment.

An interesting feature that we have observed in several cases is associated maxillary sinus involvement on the same side as the frontal infection. Clinical findings and symptoms may point only to the maxillary sinus. Treatment directed to the antrum alone does not produce the desired result. In all maxillary infections which do not properly respond, special effort is made to rule out an associated frontal infection.

The disease in children runs a very rapid course when once established, and often most radical procedures must be followed to alleviate the condition, not to speak of saving the child's life.⁸ Coffin⁹ has aptly expressed the opinion that there must exist some period during the course of a frontal sinusitis in which proper treatment would have prevented most serious complications.

Consideration of the treatment of frontal infection in children must ever be guided by the effort to preserve essential structures. Constant vigilance must be exercised during any acute nasal infection in children against the ever present possibility of frontal sinus invasion. Before we can expect any permanent relief to frontal sinus infection, attention must be directed to the anterior group of ethmoid cells, as their relation to the frontal sinus is most intimate. The employment of some type of suction treatment for freeing the nose and ostia of secretions will always be of great value.

Infraction of the middle turbinate on the affected side, followed by thorough shrinking and the application of gentle suction, has been of great value in our hands in beginning invasion. The use of ephedrin, $1\frac{1}{2}$ to 3 per cent, sprayed or dropped in the nose at very frequent intervals has facilitated drainage and aeration of the sinuses, and has proved a most valuable adjunct, lacking the deleterious effects of adrenalin or cocain. Removal of the anterior tip of the middle turbinate is sometimes necessary, especially when that structure is bulbous and obstructive. This procedure is usually done as a preliminary step to the external frontal operation. Intranasal operations alone are of little avail if much edema and redness has occurred externally in the region of the eye. We should be most reluctant to do the external operation in the absence of either external signs or intracranial symptoms. We are inclined to be rather conservative, even in cases where the external operation is found to be necessary. No attempt has been made on our part to remove completely the anterior wall of the sinus, as is done in the adult case. Merely enough of an opening is made to facilitate clear vision and to give us a reasonable amount of space in which to do the necessary work.

A thorough exenteration of the anterior group of ethmoid cells give us the necessary approach to the floor of the frontal sinus. This is opened from below and enough of the floor is removed to assure us that proper drainage will be established. We consider that by this procedure we increase our factor of safety.

We have seen two cases of generalized osteomyelitis of the frontal bone following the frontal operation in children, and these had followed most conservative exploration through

the anterior sinus wall. This same frequency of osteomyelitis following large resection of the frontal plate has been adversely commented upon by Geo. Swift in connection with his work in surgery of the frontal lobe.

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LXIV.

MENINGITIS OF NASAL ORIGIN: A STUDY IN SURGICAL ANATOMY.

By ROY F. NELSON, M. D.,

OAKLAND.

Meningitis of nasal origin is fortunately a rare disease, before which practically all surgeons stand horrified, hopeless and inactive, even when its presence is recognized early. Sufficient cases are reported, occurring both spontaneously from infectious processes in frontal, ethmoid and sphenoid sinuses and as complications of surgery on these cells or of fractures through them, to lend promise of usefulness to a method of surgical attack for their relief.

Eagleton¹ has crystallized surgical principles in the treatment of otitic meningitis, based on the function of protective reaction of arachnoid tissue, identical with that of peritoneum, and the essential need of drainage of the infected portions of its spaces following removal of the original, extrameningeal suppurative focus. His thesis is adopted in this study of similar conditions in the anterior cranial fossa. Lumbar and cisternal punctures, repeated or with continuous drainage, ventricular and corpus callosum puncture with irrigation, and laminectomy drainage are now used by various workers with occasional successes, but do not follow the principle of attack and drainage through the site of original invasion and removal of the cause. Abscesses of the frontal lobe have been drained after various classical or individual operations upon the sinuses responsible. But no proposal is found in the literature for a complete exploration of the upper group of sinuses and the adjacent meninges for the direct purpose of curing a rhinogenous infection of the latter.

Sewall² presents an operation by which exploration of the frontal, ethmoid and sphenoid sinuses can be made simultaneously, under local anesthesia, in a practically bloodless field, and a complete, safe and sure removal of their nasal walls ac-

complished under direct inspection and from the closest possible range. I had the fortune to be his first assistant while he was perfecting this technic, and have done a number of the operations. In so doing I am impressed by the fact that the line of approach is exactly parallel to the roof of the ethmoid and sphenoid, which is the floor of the anterior cranial fossa, giving clear and direct access to surgery upon it.

ANATOMY.

Study of anatomic works and dissection of cadavers gives certain facts which will be reviewed and emphasized from the standpoint of the proposed surgical endeavor.

1. Bones and Paranasal Sinuses.—The frontal sinus normally lies entirely in the frontal bone, immediately in front of the plate of the anterior fossa, which is its posterior, and, with deep backward orbital extensions, its superior wall. It is lateral to the crista galli and falx cerebri normally, but frequently extends beyond the midline anterosuperiorly. Its common wall with the cranial cavity is directly accessible at a distance of two or three centimeters in Sewall's operation, except for the superior portion, which would require only removal of the wall of the forehead for exposure if necessary.

The ethmoid cells lie lateral to the cribriform plate, between the ethmoid labyrinth and the cerebral plate of the frontal bone. The frontoethmoid articulation forms their spaces. The roofs are higher than the lamina cribrosa, which lies in the ethmoid incisure of the frontal bone. These cells lie immediately behind the orbital projection of the frontal sinus and the nasofrontal duct, are separated from them by a thin partition, and may send narrow cleftlike spaces far laterally over the orbit. The anterior cells are as accessible as the frontal sinus, and the more posterior ones extend backward in a horizontal plane parallel to the line of approach. Two foramina pass from the orbit medially in the line of articulation of the ethmoid and frontal for the anterior and posterior ethmoid vessels and nerves, respectively. The posterior marks the articulation of the cribriform plate with the ethmoid spine of the sphenoid as it passes through a foramen upward into the cranium to transmit meningeal emissaries. Posterior

to this, the upper portion of the ethmoid labyrinth, with which we are concerned (we will not discuss cells without cranial relations) articulates with the face and body of the sphenoid, and the frontal articulates with the sphenoid body and anterior border of the lesser wing.

The sphenoid sinuses always occupy the anterior part of the sphenoid body and may extend posteriorly beneath the *dorsum sellæ* and laterally into the pterygoid processes, the lesser wing, and even the greater wing of the sphenoid. As they are thrown into one cavity in Sewall's operation they will be considered as such here. From the extreme anterior end of the sphenoid body the lesser wings arise, each by two roots, the upper being slightly anterior and medial, and passing in a smooth plane across the superior face of the body to the opposite side. The optic foramen lies between the two roots. The other root of the lesser wing, and the greater wing, spring from the side of the sphenoid body posteriorly and below this, and the anterior clinoid process projects from the lesser wing lateral to the optic foramen. On the superior surface of the body the triangular ethmoid spine of the sphenoid projects forward and articulates with the *laminæ cribrosæ* on its sides, with the perpendicular plate at its apex, and is continuous with the smooth surface between the lesser wings at its base, where a transverse line, the *limbus sphenoidale*, marks its posterior boundary. The optic groove is behind the *limbus*, and runs laterally and slightly forward to each optic foramen. Behind this is the *sella turcica*. It can be seen that there is thus a flat, roughly triangular superior wall above the anterior portion of the sphenoid sinus which has immediate cerebral relation. Posterior to this, if the sinus extends so far, it is indented from above by the hypophyseal fossa, and laterally may show evidence of the carotid groove, which runs above and behind the attachment of the greater sphenoid wing, lateral to the hypophyseal fossa and posteromedial to the anterior clinoid process. The optic groove and grooves for the fifth nerve may appear on the lateral wall also. The anterior and inferior walls do not concern us here.

2. Vessels.—The anterior and posterior ethmoid vessels have been located. The carotid artery, passing in its groove on the lateral side of the sphenoid, enters the cranial cavity

behind the optic nerve and lateral to the chiasm and gives off the anterior cerebral artery, which passes forward and upward in the longitudinal fissure between the frontal lobes, close to the cortex, and between the olfactory tract laterally and the optic nerve medially and below it. Just in front of and above the chiasm it communicates with its fellow across the midline by the short anterior communicating artery, which lies well within the longitudinal fissure, and is the anterior part of the circle of Willis. The middle cerebral and ophthalmic arteries are posterior and lateral, respectively, to the entire field of study.

The cavernous sinuses lie on either side of the sphenoid body, extending forward, lateral to the optic nerve, as far as the superior orbital fissure. They communicate with each other both in front of and behind the stalk of the hypophysis by the sinus cavernosus anterior and posterior, forming the sinus circularis (Spalteholz). They lie, like all the cerebral sinuses, between layers of the dura, and are everywhere posterior or lateral, or both, to the optic nerve and chiasm. The carotid artery passes through them, and the nerves of the orbit, excepting the optic, are in their lateral wall. Their extensions backward and downward are many, but not germane to this study. The superior longitudinal sinus starts at the foramen cecum and passes backward along the midline of the calvarium in the attachment of the falx cerebri.

3. Brain, Nerves and Meninges.—A. Meninges: The usual dural relationship to the bony surface of the cranium exists as elsewhere, with certain added features of importance. Where the ethmoid vessels pass upward as meningeal vessels the dura is tightly adherent to their foramina. From the crista galli the falx cerebri extends its attachment forward and then upward along the interfrontal articulation. At the optic foramen the dura is intimately fused with the periorbita, from which line of fusion springs the annulus tendinii giving origin to the extraocular muscles. Also the dural sheath of the optic nerve takes its form and position here, extending forward to the globe. Along the limbus of the sphenoid is attached the diaphragma sellæ, a dense, taut sheet extending backward to roof in the hypophyseal fossa, attaching to the clinoid processes and then fusing with the basal dura. In it runs the cir-

cular sinus. Beneath it is the hypophysis whose stalk passes through the central opening of the diaphragm, and dura continuous with that on the rest of the cranial floor covers the floor of the fossa. Through the foramina of the cribriform plate delicate dural processes also extend, ensheathing the olfactory nerves. The tentorium cerebelli springs from the anterior clinoid processes and arches across the brain stem between them.

The anatomy of the arachnoid spaces has been amply studied by Locke and Naffziger.³ They show that the deepest portion of the cisterna basalis, the pars chiasmatis, lies immediately in front of the optic chiasm, is nearly as deep as the cisterna magna and five times the depth of the remainder of the basal cistern. It passes around the chiasm posteriorly to communicate with the partes interpedunculares and pontes. From it a lateral cerebrocortical channel passes outward in the Sylvian fissure of either side; a bilateral internal arachnoid channel passes upward and backward to surround the brain stem, passes over the basal ganglia from behind and then turns forward from above to become the velum triangulare, where it is in close apposition to the lateral ventricle; and two cerebro-sagittal channels run forward and upward around the longitudinal fissure, communicating with the last described channels at the cisterna ambiens, just over the splenium. From here a communication also reaches the cisterna magna through the cerebello-sagittal channel. These spaces are well recognized as the sites of purulent collection in diffuse leptomeningitis. It can be seen that the pars chiasmatis is the most centrally situated and widely interrelated of the cisternæ.

The prolongations of arachnoid and fluid sheaths along the optic and olfactory nerves are of only passing import here.

B. Encephalon and Nerves.—The cerebral lobes occupy their familiar positions and are in close approximation to the dura except above the arachnoid spaces outlined. The tuber cinereum lies upon the diaphragma sellæ and sends its infundibular stalk to the hypophysis in its fossa. Anteriorly and laterally to this the olfactory tracts arise, pass forward beneath the substantia perforata and become the olfactory bulbs lying upon the cribriform plates and sending the olfactory nerves through the foramina. In so doing they pass over the

lateral part of the ethmoid spine of the sphenoid, and are attached to bone only anterior to its articulation with the ethmoid.

Medial to the olfactory tracts, and below them, the optic chiasm lies in its groove just behind the limbus of the sphenoid, with each optic nerve converging to it in a faint groove from the optic foramen. These are medial to and beneath all the other intradural structures described.

Summarizing the anatomic points brought out, with a good atlas, illustrating a view of the anterior cranial fossa from above and a lateral sagittal view, before us, it becomes surprisingly clear that the cisterna chiasmatis and the subarachnoid space adjacent to the ethmoidal sinuses should be immediately and safely accessible through the roofs of the latter and of that anterior portion of the sphenoid composed of the ethmoid spine and in front of the line of the limbus, could we reach them and orient ourselves by landmarks.

OPERATIVE APPROACH.

Sewall's external frontoethmoidectomy must be done completely. Both anterior and posterior ethmoid vessels must be ligated intraorbitally. All frontoethmoid intercellular partitions must be removed completely to give a smooth roof, and medially up to the cribriform plate, which is easily outlined and examined in this way. Of course, no intranasal structures above the middle meatus can be left. The sphenoid face must be removed completely to the roof and lateral wall and downward enough to give ample exposure of the interior and working room. The intersphenoid septum must be removed with posterior submucous resection.

This gives a clear view and access to the region above described. The lamina cribrosa is identified, and its articulation with the sphenoid is at the point of emergence of the posterior ethmoid artery. The optic foramen, marking the lateral extremity of the ethmoid spine of the sphenoid, is just lateral to the upper anterior corner of the sphenoid sinus. An obvious extension from here may enter the roots of the lesser wing to partly surround and outline the foramen. The limbus is at the posterior border of the flat anterior portion of the sphenoid roof, about 1.5 centimeters from the anterior wall, or where the depression of the hypophyseal fossa commences (allowing

two to three mm. here for safety). The optic chiasm lies above and behind this line, and the nerve runs from the foramen to the midline here. Above the triangle whose base is a line between the optic foramina and whose sides run from the foramina to an apex at the center of the limbus lies the cisterna chiasmatis, and it may be reached as far forward as the posterior ethmoid arteries.

Following Eagleton's suggestions, while acquiring this exposure and these landmarks, one would watch for bony dehiscences, ruptures, necrosis, granulations and thrombosed vessels. If such were found he would return after completing the above steps and carefully expose the dura by removing bone at this point. Without such clues or evidence making lateralization possible, both sides should be completely operated upon for exposure before entering the cranial cavity. If still unable to determine the point of invasion, one would start preferably about midway back in the ethmoid labyrinth and proceed backward, removing the bone with fine forceps or chisels after carefully elevating dura beyond, from the lateralmost extension of the ethmoid roof to the cribriform plate. This exposure would be carried to the posterior border of the cribriform, where one would turn medially, between the optic foramen and the posterior ethmoid foramen for meningeal vessels, and remove the roof of the sphenoid in the above described triangle. Now the dura could be incised and the infected subarachnoid spaces drained. If the point of invasion is found, a small anteroposterior incision should be made there. Should this be above the sphenoid, the operation would then be completed. Otherwise the cisterna chiasmatis could be drained, if deemed necessary, by an incision started anterolaterally on the side of involvement near the base of the triangle of exposure, and extended carefully with fine nasal scissors to within a few millimeters of the midpoint of the limbus. If the site of invasion was not localized, cisternal drainage alone might be preferable. The cribriform should be left alone unless involved. This would be a prolonged and tedious work, but the clear exposure and orientation would make it worth while. I have verified the technic on the cadaver. Of course, free use of opiates would be essential to the patient's endurance.

Eagleton adds ligation of the common carotid as an essential step. With unilateral involvement at least, this should be done on that side. Immunizing transfusions, etc., should be given as part of the after care. The nasal space should be aseptically cleansed of clots and crust daily with forceps and dry gauze strips, and the patient kept strictly in dorsal decubitus with the head slightly elevated for a prolonged period.

WHEN TO OPERATE.

My clinical knowledge of this subject is purely academic. I have never had direct contact with such a case. And here, as in otitic meningitis, diagnosis, and early diagnosis, is the means to success. I can only refer to Eagleton's differential points: Headache of suggestive type, vomiting, fever, variable pulse, frequently slow in proportion to fever and general condition, restlessness, delirium, convulsions, occasional psychic blindness, indentations of visual fields and dilated retinal vessels, aphasia and euphoria, usually increased spinal fluid pressure, globulin or cell count (or all three) and cervical rigidity with basal involvement. Others have stressed choked discs, retinal hemorrhages and loss of pupillary reaction. Gingold⁴ claims a reflex strabismus on flexion of the head is an early sign of basilar meningitis. Positive Kernig sign probably means a diffuse, incurable process. Unfortunately for the present purpose, we seldom meet the necessity for surgical exploration and drainage in acute sinusitis for its own sake as we do in mastoiditis, and the burden of accurate diagnosis is heavier and sharper in its demand on this account. Diagnostic skill and methods should develop with earnest work on this problem.

SUMMARY.

An anatomic study extended from the points of Sewall's external ethmoidectomy shows that the subarachnoid spaces of the anterior cranial fossa are clearly and safely accessible through the roofs of the ethmoid and sphenoid sinuses between demonstrable landmarks and in front of the optic chiasm, which is the nearest important structure to the proposed route of approach, and that extension of the accepted principles of sur-

gery of meningitis of extrameningeal origin to this region seems feasible by the technic described.

CONCLUSIONS.

1. Anterior subarachnoid drainage should be possible in meningitis originating from the paranasal cells bordering the cranial cavity.
2. Extension of the approach for successful interference in cavernous sinus thrombosis seems doubtful.
3. The usefulness of anterior drainage in other forms of meningitis must be determined by those with experience and opportunities for practice in this field.

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LXV.

FRONTAL SINUSITIS COMPLICATED BY EXTRA-
DURAL ABSCESS AND FRONTAL
LOBE ABSCESS.*

By J. MACKENZIE BROWN, M. D.,

LOS ANGELES.

C. C., male, aged 19, went swimming in a plunge on December 14, 1925. The following day he developed an acute rhinitis with some fever. He stayed at home for five days, and at the end of this period he had no fever and few nasal symptoms. He returned to his occupation as clerk and remained at work for four days (December 24th), all nasal symptoms having disappeared.

On December 26th (12 days after swimming) he suddenly developed pain and marked tenderness over the left frontal sinus and temperature of 103. Opiates were required to control the pain. The pain gradually lessened but the tenderness persisted. Four days later (January 1st) swellings appeared over the left eye and over the upper part of the sternum, temperature ranging from 99 to 100 degrees in the morning and from 102 to 103 degrees in the afternoon. He was sent to the Pomona Hospital, and Dr. Robert Smith, who had been looking after him up to this time, called in Dr. B. A. McBurney. Fluctuation appeared in both swellings a couple of days later and were opened by Dr. McBurney; pus was obtained from both. Cultures from these showed streptococci. The boy rapidly improved, no pain and much less tenderness over left frontal and the fever gradually disappeared. A week later (January 9th) he was sent home. There had been no discharge from the nose for the past ten days.

He was perfectly well for four days. On the fifth day after his return from the hospital he had a severe headache. The family physician was called. Examination showed normal

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temperature, normal pulse, some tenderness over the left frontal. He complained of no pain but the persistent headache. One-fourth gr. morphin was given, which gave him little relief, another one-fourth being necessary in an hour. This gave him relief for seven or eight hours, when the headache again returned. At this time he was sent back to the hospital. Dr. McBurney examined him and reported temperature normal, pulse normal, no pain but severe headache, not localized, tenderness over left frontal but not marked, a ptosis of the left upper lid, left optic disc moderately swollen. General physical examination negative, urine negative. Blood—Hemoglobin 80 per cent, R. B. C. 4,190,000, W. B. C. 17,300, polp. 77, lymph 19. The patient vomited several times that day. Morphin was required at frequent intervals to relieve the headache. He became unconscious during the night. I saw the patient the next morning, the 15th. Examination showed the boy to be still unconscious, and the same condition prevailed as on the previous day, except the temperature was 99.6, pulse 116, left pupil dilated and did not respond to light, and the disc was more swollen than the day before. Our preliminary diagnosis was some intracranial lesion, from an acute frontal sinusitis. X-rays had been ordered but were spoiled in the development.

Operation.—The sinus was opened from below where the abscess had been previously opened, the incision being below and paralleling the eyebrow. We found a considerable portion of the lower wall, extending up to and including part of the anterior wall, to be necrosed. All the diseased bone was removed. The membrane in the sinus was thickened throughout and especially so on the floor. On the posterior wall, about the center, the membrane was lacking over a space the size of a nickel. There was a little thin pus in the sinus. The frontal duct was patent.

After removal of the membrane and the diseased bone over the lower and anterior wall, I removed the bone on the posterior wall, which had been denuded of membrane. The first piece removed was followed by a flow of pus, about a teaspoonful in all. The bone was necrosed for an area the size of a nickel. The dura was thickened and covered with granulations over this area. No perforations were found in it. A drain

was placed in the sinus up to the dura and brought out into the outer wound, which was stitched up, leaving opening enough for adequate drainage. The next day, January 16th, the patient was conscious, feeling much better, no headache, temperature 100.5, pulse 100, and able to take nourishment. The boy continued to improve; temperature and pulse did not exceed 100 until the 22nd of January, when he again complained of the same type of headache as formerly, and in an hour became unconscious. I went out to the hospital, Dr. McBurney having been called out of the city.

I reopened the old wound and found the sinus to be in a satisfactory condition. I then removed more of the posterior wall of the sinus to be sure there were no more pockets of extradural pus but found none. I decided to explore the frontal lobe and opened the dura external to the old abscess and went back of it but found no pus. I next went back and out to the temporal side and struck pus, at least one ounce, about one-half inch behind the surface. A drain was inserted into this abscess cavity and through the external wound. The next day he was conscious with no headache, elevation of temperature or pulse, and remained so for four days, when he became very drowsy. I went out again and found the dressings had not been put in the abscess cavity. After the abscess cavity was properly dressed he went on to complete recovery. Bacteriologic examination showed streptococci from both the extra- and intradural abscesses.

Case No. 2.—In 1912 I had a somewhat similar case. The history is very brief. A. B., male, aged 50, a carpenter, came into my office late in the afternoon with the complaint of severe pain and swelling over the left eye; duration four or five days and said that he had a cold a few days prior to the onset of the severe pain.

Examination showed a thickening of the periosteum over the left frontal region; the upper eyelid was moderately swollen. The whole sinus was very tender. The left nares contained a small amount of pus, coming from under the middle turbinate; temperature 101. As the middle turbinate was very tight against the lateral wall, I removed the anterior tip to facilitate the drainage. I tried to wash the sinus but was unsuccessful on account of the tenderness of the parts. He was sent to

St. Vincent's Hospital and given opiates for the pain. The next morning I found that he had a very restless night, a second opiate giving little relief. The swelling over the eye was greater than the previous day; temperature 101.

He was sent up to the operating room. The sinus was opened externally; the lower wall was partially necrosed; the membrane was thickened throughout and was removed. On the posterior wall the bone was gone for an area the size of a dime. The dura was covered with granulations. The sinus was packed with iodoform gauze and drained through the external opening. This man made an uneventful recovery and in about three weeks returned to work.

Two months later, while I was away on my vacation, he became suddenly ill and was taken to the hospital. He was unconscious when he arrived there and died in a few hours. A postmortem by Dr. John C. Wilson showed a frontal lobe abscess on the left side.

Dr. Ross Skillern reports a case of frontal sinusitis with extradural abscess, which he read before the American Laryngological Association in 1922, and he reviews the whole subject thoroughly, especially the pathology. I can do nothing better than to quote from this masterly paper. He says that "these cases occur much more frequently in acute than chronic sinusitis, and that they are due to an especially virulent infection; that the primary organism is streptococci or pneumococci, and that these organisms soon become choked out by the staphylococcus pyogenes aureus; that the former cause a very high mortality by their rapid involvement of the vital parts, but the latter being slow in their spread give surgery a chance for adequate drainage.

"As far as the pathologic process for the intracranial infection is concerned, it would appear as though spreading by continuity, together with perforating veins, play the most important rôle. In this way the perforation of the bone is caused by the pressure of the secretion on the mucosa, thus furthering ulceration and necrosis of the periosteum. The vena perforantes carry the infection through to the meningeal side, setting up a periostitis at that point. The bone, thus being deprived of its nutrition on both sides, a localized solution of continuity occurs, resulting in a necrosis, followed by se-

quester formation. The osteomyelitis, with softening, may extend around the venous passages for some distance."

Symptoms.—Skillern lays stress on the sudden appearance of swelling of the upper eyelid, this being rarely seen in uncomplicated cases, and is practically pathognomonic of rupture of one or more walls. I concur strongly in this. Headache, Skillern thinks, is of little diagnostic value, yet I believe that any headache developing in the course of an acute sinusitis that is unrelieved by ordinary means and is persistent is very suspicious of intracranial involvement. Levy states that an extradural abscess will cause a more severe type of headache than the intradural. Persistent pain in the region of the sinus that is difficult to relieve is also suspicious that all is not well within. Pulse and temperature have been of less value to me. X-ray is a valuable diagnostic aid.

Treatment.—In any case of frontal sinusitis with suspected intracranial involvement, the sinus should be opened and explored at once. If intracranial involvement is diagnosed, the posterior walls should be opened and the frontal lobe explored, if necessary. If in the course of an acute frontal sinusitis you have external swelling, persistent pain unrelieved by ordinary means, I believe external drainage of the sinus may prevent at least some cases of intracranial involvement.

LXVI.

MALIGNANT NEOPLASMS OF THE ANTRUM*.

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In order that we may cover our subject more thoroughly, it has seemed best to limit the scope of this paper to a consideration of malignant neoplasm only, and to omit those classified as benignant.

Although the existence of the maxillary sinus was known to Galen (130-201 A. D.), and although this sinus was accurately described by Nathaniel Highmore in 1651, malignancy in this region received little attention until within recent years. Many modern writers make the statement that malignant neoplasms of the antrum are of rare occurrence. Possibly it is for this reason that many textbooks make no reference to the subject, while others merely mention that such growths may occur. For example, Cornelius B. Coakley's textbook, published in 1899, makes no mention of malignancy of the sinuses; in a recent edition, however, he devotes several paragraphs to a discussion of these conditions. Joseph C. Beck and Harold Hays, in their new books, published within the past year, give no space to a consideration of malignancies of the sinuses.

The first attempt to consider malignant neoplasms of the antrum in any comprehensive manner was made by Wendell C. Phillips in 1898. At that time he was able to collect from the literature 16 cases of primary carcinoma of the antrum, to which he added one case of his own. Since that date a considerable literature has grown up about the subject. Indeed, a survey of the recent literature makes it evident that malignancy of the maxillary sinus can no longer be classed as a very rare condition.

INCIDENCE.

While malignant growths of the antrum are by no means a common condition, particularly those whose primary origin

*Candidate's thesis, presented to the American Laryngological, Rhinological and Otological Society, May, 1927.

is in this sinus, secondary invasion of the antrum by growths arising in adjacent structures is somewhat more frequent. Curtis (1900) quoting figures from Heymann's *Handbuch der Laryngologie und Rhinologie*, says: "M. Schmidt found 9 cases in 42,635, or 0.021 per cent; in the Universitäts Poliklinik, Berlin, he found only 2 instances of malignancy of the maxillary sinus in 27,000 cases."

Recently, Ewing reports that in 1916-1917, of 1,892 cases treated at the Memorial Hospital, 48, or 2.53 per cent, were of nasal origin; of these 35 involved the maxillary sinus. D. Crosby Greene, reviewing the six-year period from 1916 to 1921, found 84 cases of carcinoma of the antrum treated at the Huntington Hospital in Boston. New of the Mayo Clinic, in 1920, writes that during the two and one-half-year period, January 1, 1917, to July 1, 1919, 33 malignant tumors of the antrum were examined at that clinic. In a recent article, covering the eight-year period 1917 to 1924, he has added to the earlier series, bringing the number up to 168 cases of malignancy of the antrum of Highmore. Of these, 129 were primary, while in 39 cases the tumor of the antrum was secondary to a malignant growth of the upper jaw. Among others who have had under their observation rather large series of cases of this type of malignancy are D. Crosby Greene, who reports on 84 cases, and F. M. Johnson, whose series included 24 cases.

CLASSIFICATION.

Ewing, in his work on Neoplastic Diseases, recognizes the following types in connection with the accessory nasal sinuses:

1. Papillary, some of which are malignant transformations of papillomata.
2. Carcinomata of the basal cell type, often designated as adenoid cystic epitheliomata.
3. Squamous cell carcinomata, which are metaplastic from previously altered lining epithelium.
4. Cylindrical cell carcinoma—a bulky tumor, unusually malignant (adenocarcinomatous).
5. Round cell carcinomata of atypical structure, which is often designated as sarcoma.
6. Dental tumors, including the squamous and glandular types of adamantinoma.

Taking the various types in the order of their occurrence, Waugh classified them in this way:

1. Sarcoma—round cell, lymphosarcoma, fibrosarcoma, osteosarcoma.
2. Epithelioma—basal cell, squamous.
3. Malignant fibromyxoma.
4. Malignant tumors of mixed type (lymphangioendothelioma).

This author finds that squamous cell epithelioma is most malignant, and the maxillary sinus most frequently involved.

Alfred Denker and G. Fischer Brünning, in a recent contribution, say: "Of the malignant growths in the accessory nasal sinuses are found more frequently sarcoma and fibrosarcoma, less frequently lymphosarcoma, and lastly there occur carcinomata, hard papillomata, adenomata, endotheliomata and cylindromata." Pratt, on the other hand, says: "Primary sarcoma is rare. Sarcoma is not uncommon. Carcinoma is met with in the form of squamous epithelioma, or alveolar carcinoma, chiefly in advanced age. Any of the varieties of sarcoma may be met with in the nasal fossæ."

E. D. D. Davis, who reported 39 cases of malignancy of the maxillary sinus, found the cases divided as follows: Squamous carcinoma, 19 cases; round cell sarcoma, 5; endothelioma, or columnar carcinoma, 7; papillomatous growths, 3; chondrosarcoma, 2; spindle cell sarcoma, 2; melanotic sarcoma, 1.

In New's series of 129 primary tumors of the antrum, 82 cases were squamous cell epithelioma, 9 were sarcoma, 4 lymphosarcoma, 9 fibrosarcoma, 1 osteosarcoma, 6 adenocarcinoma, in 6 cases the type of malignancy was not determined, and in 13 of undoubted malignancy no microscopic examination was made.

EMBRYOLOGY.

In connection with the origin and etiology of malignant growths of the antrum, it may not be out of place to sketch briefly the embryology of this sinus. Jacob Parsons Shaefer, in 1910, made a very comprehensive study of the maxillary sinus and its relations in the embryo, child and adult. He

writes that during the second month of intrauterine life, before the *cavum nasi* and *cavum oris* have become separate cavities, three swellings are found on the lateral wall of the nasal fossa, the maxilloturbinal appearing first, the ethmoturbinal next, and the nasoturbinal (extremely rudimentary in man) appearing later. The ethmoturbinal undergoes subdivision, according to Killian, there being five ethmoturbinal plates, defined by six grooves, as a rule. Shaeffer found that the number of these grooves varies greatly. The ethmoturbinal plates become reduced in number as development proceeds, and they finally represent the *conchæ nasales*, medius and superior, respectively. Just how the primitive nasal processes and furrows are formed is variously interpreted. A number of observers believe that they are the result of outpushing or outgrowing of the mucous membrane of the lateral wall of the nasal fossa. It seems, however, that about the tenth week of fetal life the mucous membrane in the middle meatus of the nose begins to pouch laterally. This pouch represents the anlage of the sinus maxillaris, which pushes from the originally simple furrow, separating the maxilloturbinal and the first ethmoid turbinal. The primitive maxillary pouch has relations of importance. These structures are the *processus uncinatus*, the *infundibulum ethmoidale*, the *hiatus semilunaris* and the *bulla ethmoidalis*. The pouch gradually develops into the pyramidal cavity, leaving the place of communication with the *infundibulum ethmoidale* at the point of primary invagination. It is, therefore, quite evident that these structures, which bear so close a relation to the anlage of the sinus maxillaris, must now bear even more important relations to the *ostium maxillare*.

The earliest evidence of the mucosa of the lateral wall of the middle meatus is noticeable about the seventieth day of fetal life. By the end of the third fetal month, the sinus maxillaris occupies a definite space in the lateral wall of the nasal fossa. By the simultaneous process of resorption of the surrounding tissue and the growth of the maxillary pouch, the primitive cavity gains more and more capacity, and soon acquires a slitlike shape at the side of the nose. In the embryo, the *processus alveolaris* of the maxilla is in proximity to the orbit, and unerupted teeth are contained in this situation;

hence it is evidence that the maxillary sinus is very small at this time. Its growth is rather uniform, and the first dentition has little to do with its increase in size. The age of the child and the size of the sinus progress *pari passu*. After the eruption of the permanent teeth, the sinus begins to lose its rounded and elongated shape, and to assume the adult pyramidal form. The sinus reaches its full size between the fourteenth and eighteenth year, and occasionally at this age sarcoma has been observed.

The mucous membrane lining of the sinus is thin and firmly adherent to the periosteum, except around the ostia where it is rather thick and loose. Below the epithelium is a thick hyaline basement membrane, and under this a mucosa of fibrous tissue, with numerous lymph corpuscles in it.

Because of the relationship of the maxillary sinus to the floor of the nose and to the alveolus, it is to be expected that disease of these structures will involve the sinus. The layer of bone between the roots of the teeth and the floor of the sinus varies in thickness in different skulls. When it is comparatively thin, the projecting tooth fangs form elevations of greater or less degree on the floor of the sinus. Direct communication between the fangs of the teeth and the mucous membrane of the sinus, due to extreme hollowing out of the *processus alveolaris* of the maxilla, occurs most frequently in the aged. Ridges, crescentic projections and sometimes septa on the sinus wall, are found, and these conditions offer at times almost insuperable obstruction to drainage, and thus undoubtedly play a part in initiating pathologic processes, and in setting up chronic irritation.

ETIOLOGY.

A number of writers express the opinion that malignant growths have their origin in previous disease conditions. Thus Phillips describes cases which he collected as "boring epithelioma," occurring in connection with a tooth or tooth socket. One case which this author reports is of special interest as indicating that carcinoma may have its origin in an ordinary polyp.

The patient, a man aged 58, suffered pain in the right antrum six years previously, especially radiating to the teeth.

One and a half years before an opening was made into the antrum through the alveolar process; there was very little discharge of pus or blood. The opening was never closed, and four months before the man came under observation a growth was noticed around the opening. The growth had increased rapidly in size. Transillumination showed a dark area over the antrum. The pedicle of the growth was in the antrum. The mass was removed with a snare, and the antrum curetted. Uneventful recovery followed. A microscopic slide showed epithelioma (squamous) at one end of the polyp.

Epithelial rests in connection with a tooth socket may account for the development of malignancy in some cases.

Another case in which a tooth or tooth socket seems to have been connected in an etiologic way with a carcinoma of the antrum is reported by George E. Shambaugh.

In this case, that of a man aged 60, the sole complaint was a sensation of pressure on the right side of the face of only a few weeks' duration, following an acute cold in the head. Transillumination showed a shadow over the right antrum. Irrigation of the sinus gave a mucopurulent secretion. Decayed molars were removed. Two months later there was increased pain, loss of weight and cachexia. The right eyeball protruded somewhat and was fixed. Exuberant newformed tissue protruded from the unhealed tooth sockets. The growth was found to be carcinoma. Resection of the superior maxilla was performed. Death ensued.

Gleason, writing of nasal sarcoma, says it may occur as a primary growth, or result from degeneration of fibrous polypi or papillomata. A. Logan Turner states that malignant tumors developing in the nasal sinuses are frequently associated with sinus suppuration and with the presence of nasal mucous polypi.

It seems rather remarkable, in connection with these statements, to note that E. D. D. Davis, in his report on 39 cases, says: "Anything approaching a precancerous condition has not been observed, and none of the patients in this series had any previous affection of the nose." A number of cases have also been reported by other writers in which no symptoms

referable to the nose or accessory sinuses were manifested prior to those associated directly with the malignant growth.

That a malignant tumor of the antrum may have its origin in a cyst is illustrated by a case reported by Gütlich.

In a boy of 14, the lateral wall of the antrum protruded toward the nose, the floor toward the palate. During the removal of the tumor, which was the size of a small apple, the dense capsule covering the growth was torn, and an amber colored fluid escaped. The crown of one tooth was adherent to the tumor; a second tooth was found above the tumor in the floor of the orbit. This was a case of follicular dental cyst with secondary degeneration. Histologically, part of the tumor showed a marked follicular structure, with cylindrical cells in the interior of the cavities. Along the sides of this were cords and nests of epithelial structures resembling carcinoma. In other localities, irregularly arranged connective tissue elements could be observed, the cells showing spindle like dilatation, like sarcoma cells. A trial operation had led to superfluous resection of the superior maxilla.

It would also seem that trauma may have some influence, if not in originating a malignancy, at least in accelerating its growth, as in a case cited by Theodore Blum.

A woman, aged 65, about four weeks before coming under observation, had been struck on the left side of the face by a rubber ball. She experienced no discomfort for two weeks; her face then began to swell on this side. Examination revealed marked swelling in the canine region. On deep palpation a small mass was found, with suggestion of fluctuation. The X-rays revealed entire loss of bony structure in the left maxillary premolar and molar regions, as compared with the normal right side. The left frontal sinus was extremely large, the right of average size; both were deep, with a thin anterior wall. The ethmoids were moderately involved. The clinical diagnosis was primary carcinoma; the laboratory report showed squamous cell carcinoma. This patient was treated with radium and then operated upon, and after a year there was no recurrence.

Callifas and Quigley report the case of a man struck by a baseball on the left maxillary bone. The dentist, on extracting a tooth, found that it offered no resistance. Examination

showed the whole antrum filled with a mass, which microscopically was carcinoma.

Just what influence the injury had in these cases remains an open question. It appears that the malignancy must have been present before the injury occurred, or possibly the association of the trauma and the malignancy was merely a coincidence.

In describing three cases of carcinoma involving the antrum and ethmoid, in all of which there was a clear history of long standing chronic suppuration, A. J. M. Wright says: "It seems logical that chronic suppuration may be a frequent precursor of cancer in this region as it is known to be in other parts of the body."

With reference to the location from which malignant tumors of the accessory sinuses arise, A. Logan Turner says: "Malignant tumors developing primarily in the nasal sinuses usually originate in the maxillary or ethmoid cells. In many cases, however, when the operative area is exposed it is difficult to determine the exact origin of the growth, owing to the fact that cases come under observation in the later stages, when the disease has extended from one cavity to another."

Zukerkandl states that malignant growths originate in the walls of the antrum and, as has been pointed out before, some of these growths have their origin in mucous polypi. Curtis, in reporting six cases of carcinoma, found that most of them had their origin in degenerated polypi.

In Davis' series the majority of cases of squamous carcinoma began in the ethmoid and spread along the orbital plate, while a few originated in the orbital plate itself. The soft, friable, suppurating growth, taking the line of least resistance, fills the antrum, then erodes and absorbs its walls and sprouts through, becoming adherent to the orbital contents. The thin bone of the facial wall was frequently perforated near the infraorbital foramen, or in front of the malar recess of the antrum, and thus the characteristic puffy swelling below the eye is produced. More extensive growths may perforate the posterior wall of the antrum into the pterygoid fossa, where it is impossible to thoroughly eradicate the disease.

It is of interest to note that statistical studies indicate that almost two-thirds of the malignant tumors of the antrum occur in males.

SYMPTOMS AND DIAGNOSIS.

The symptoms of malignant growth in the antrum are those of a rapidly growing tumor, which fills the antral cavity and breaks through the wall of the nose or the pharynx. Pain of a boring or lancinating character is one of the early symptoms, and, unfortunately, by the time this symptom appears the growth is quite well advanced. Other symptoms are bleeding, especially on instrumentation, swelling, nasal obstruction and glandular involvement, though writers seem to agree that glandular involvement is not as frequent, and does not occur as early with neoplasms of the antrum as with those in other localities. The large gland at the angle of the jaw seems to be the favorite site for the first appearance of glandular involvement. Blum says that a soft swelling, on either the buccal or the palatal side of the maxilla, covered with normal mucosa, practically painless, even with a suggestion of fluctuation, and a typical loss of bone, as shown by the intraoral X-ray films, in a patient past middle life, is typical of early primary carcinoma of the antrum. However, these characteristic symptoms are by no means always present, as is illustrated by a case reported by A. Bloch and J. Tarneaud.

This patient never showed any indication of tumor formation. From the beginning there was trismus, neuralgia and suppuration, which caused the presumption of an ordinary sinusitis. Exploratory puncture revealed a neoplasm—an epithelioma. The tumor extended backward toward the pterygo-maxillary fossa, and was in such an advanced stage that it was not deemed advisable to have recourse to surgery, so radium was employed. Under this treatment improvement was so marked for a time that it was thought a cure would result, but there was a recurrence *in situ*.

Hansen, who has recently reviewed the subject of carcinoma of the antrum, and who describes sixteen cases culled from the literature, reports a case which serves well to bring out the symptomatology and also the difficulties of early diagnosis.

A woman, aged 39, seen for the first time on September 1, 1924, complained of intermittent pain and tenderness on the right side of the face and around the eye, with a particularly

tender spot on the gum of the second molar. A dentist extracted the second molar without relieving the pain. Examination of the nose gave negative findings. Externally nothing was found except a large firm gland about three-quarters of an inch in diameter at the angle of the jaw. Transillumination showed the right antrum to be dark. Fluid used for irrigation seemed to meet with resistance in the antral cavity, and was returned with a slight amount of mucoid secretion and some blood but no pus. The roentgenograms gave definite evidence of involvement of the maxillary and ethmoid sinuses on the right side, but no evidence of bony pathology. The patient disappeared for a time, and when she returned the swelling on her gum had enlarged; it had been opened by a doctor who told her it was an abscess. She was advised to see a good dentist and went to the Dental School of the University of Minneapolis. There a small piece of tissue was excised, which proved to be squamous cell carcinoma. Examination on October 5, 1924, revealed a very extensive growth filling the entire right antrum. The right posterior choana was entirely filled with the growth, and the right cheek was bulging, as was the upper jaw and alveolar process. There were three palpable glands in the right cervical region. Operative treatment held out no hope. Radium treatment was administered at the Mayo Clinic. At the time the case was reported the patient's condition was very low.

As Hansen points out, where the diagnosis is in doubt no harm is done by opening through the canine fossa and doing a Caldwell-Luc operation. He believes that in the above case this should have been done at the time the enlarged gland was discovered instead of a month later.

Every patient with symptoms of malignancy should receive a roentgenologic examination. Two points of the utmost importance are to determine the precise relation of the roots of the teeth to the floor of the antrum and the presence of a neoplasm, as well as its size and shape. It is customary to have one posteroanterior view and one lateral. The making of an intraoral film is also important. When general information concerning the sinuses is desired, it is best to have three views, an anteroposterior and two oblique views, and all possi-

ble routes of extension of the growth should be studied with care.

Transillumination is likewise a valuable diagnostic aid. A review of the reported cases shows that this procedure has been called into service in nearly all cases and has usually supplied confirmatory evidence of pathology. The consensus of opinion, however, is that these aids to diagnosis should not take precedence over clinical evidence.

In differentiating malignant growths from polypi, where confusion is most likely to occur, Coakley points out that malignant growths are characterized by destruction of the nasal cavity, while the growth of polypi is slower: malignant growths cause sharp, lancinating pain, while nasal polypi merely cause a sensation of fullness and discomfort. Polypi rarely ulcerate, while malignant growths often ulcerate and bleed easily.

Other conditions from which malignancy must be differentiated are the various forms of dental pathology, such as carious teeth, root abscesses, osteitis of the alveolar process, infected dentigerous cysts, tuberculosis and syphilis in the tertiary stage, with necrosis of bony walls (Hansen).

PROGNOSIS.

As there is a wide variation in the degree of malignancy of different growths in the accessory sinuses, the prognosis naturally varies greatly. For sarcoma, especially in childhood, where the growth can be thoroughly removed, the prognosis is fair. There seems to be less tendency for these growths to return than in any other form of malignant disease. In fact, in other types the prognosis is extremely bad.

TREATMENT.

In the treatment of malignant neoplasms of the maxillary antrum, resection of the maxilla formerly constituted the main reliance, but the end results were so extremely disappointing that this procedure has been practically abandoned. The operative mortality was not high, but recurrence was the rule.

The mortality rate following resection of the jaw, as reported by the European clinics, is from 12 to 30 per cent (New). Kocher states that after resection of the jaw for

malignant tumors, recurrence is the rule because removal of all diseased tissue is not certain by our present methods. Schley finds that the average operative mortality of resection of the upper jaw in America has been from 12 to 13 per cent. Bloodgood (quoted by Greene) has been unable to find in his records of thirty years one solitary case of proven carcinoma of the antrum cured by excision of the upper jaw.

A great variety of surgical procedures have been proposed for dealing with malignancy in the region under consideration, but as these are practically all modifications of the Caldwell-Luc or Moure operations, with which all operators are familiar, it is needless to describe these in detail.

Since the cervical glands may become involved, it is usually a measure of safety to remove these at operation.

As the results of surgery alone have been so disappointing, many efforts have been made in recent years to deal with these neoplasms by other means, and all manner of combinations of surgery with X-rays, radium and diathermy have been employed.

George B. New, in 1920, reported a series of 33 cases, 18 of which were treated by the use of the cautery and radium, a soldering iron at dull heat being used as a cautery. At that time he states that the combination of the cautery and radium has eliminated the operative deaths usually associated with this disease, and has decreased the number of recurrences. He has recently published an article (*Archives of Otolaryngology*, September, 1926), based on 168 cases of malignant disease of the antrum, in 97 of which this treatment was used. He affirms that this additional experience serves to confirm his earlier conclusions. More extensive tumors can be treated by this method than by surgery alone. The patients selected for this treatment by New were those who appeared to have a reasonable chance of being cured by the implantation of radium directly into the tumor. Of the 97 patients with primary tumors of the antrum, 36 per cent are living from two to eight years or more, while 64 per cent are dead or have recurrences. New points out that a knowledge of the pathology of the different types of tumors is essential in determining their treatment. The rapidly growing sarcomas respond well to radium, so it is not essential that this group be so well cauter-

ized as in cases of squamous cell epithelioma. The mixed tumor type does not require such radical treatment. After using the cautery, radium salts or emanation tubes were introduced into the antrum at the point where they seemed to be most needed, either at the time of operation or ten days to two weeks later, after some slough had cleared up.

In a series of 84 cases of carcinoma of the antrum observed by D. Crosby Greene, 36 were treated by operation, followed by irradiation; of these, 12 patients are living and well, without recurrence at periods ranging from one to five years; only six patients have passed the three year limit and can be considered as probably cured. Of 33 patients treated by radium alone, only one was apparently well two and one-half years after beginning treatment. According to Greene's method, the growth is removed by the most suitable radical operation, and then steel jacketed radium tubes, covered with rubber tubing, are applied to the periphery of the cavity, being distributed over the surface and held in place by gauze packing, soaked in sterile albolene. The dosage employed varies from 500 to 1,000 millicurie hours.

F. M. Johnson reports 24 cases, 12 males and 12 females, treated somewhat after the same plan. Of these, four were unimproved; four showed satisfactory response to operation, and eight showed both local and general improvement, although they were never free from nasal growth. The four patients who showed a satisfactory response have had no recurrence for periods ranging from one to five years. One patient was free from the disease for six and one-half years when recurrence took place, showing that it is hardly safe to consider a patient cured even after this length of time.

This patient, aged 47, came to the hospital in September, 1916. His illness began three months earlier with the appearance of a small lump in the alveolar process of the right upper jaw. The right side of the face became swollen and a dentist removed a tooth; the socket never healed. At the time of admission there was an egg shaped ulcerated mass, 3 by 5 cm. projecting from the alveolus and palate. There was no involvement of the ethmoid region, and there were no palpable nodes in the neck. The neck vessels were ligated, the remainder of the floor of the antrum was removed, and unfiltered radium

was applied. After a few weeks large portions of slough and dead bone came away, leaving a healthy cavity. There were no further manifestations of the disease until 1923, when a recurrence was noticed close to the floor of the orbit. A finger cot of emanation tubes was packed close to the tissue. In a few weeks the cancer area sloughed away, exposing the floor of the orbit. A small discharging fistula formed below the eyelid, communicating with the anterior antral wall, a portion of which was destroyed. Later part of the orbital plate sloughed away. At the present time there is no evidence of new growth.

Another advocate of the combined treatment is Harry A. Barnes, who emphasized the importance of removing not only all tumor tissue but the cheek flap as well, and then applying radium, the patient receiving three or four treatments at weekly intervals. He believes the wide opening should be left permanently for purposes of observation.

An interesting case described by Barnes is that of a woman, aged 46, whose right cheek began to swell in August, 1917. Three molar teeth were extracted because of pain and increased swelling. Examination on September 3rd revealed a mass filling the right nostril, and the nasopharynx was filled with the same type of tissue. On October 18th the growth was removed from the antrum and nares. Section showed it to be carcinoma. A long course of radium was given, but a second operation became necessary. On May 14, 1918, the antrum, ethmoids and sphenoids were exenterated; the nasal septum was nearly completely removed, and also the right upper alveolus and palatal process of the superior maxilla. A course of radium treatment was again given, and up to June 1, 1920, there was no recurrence.

In 1922, E. Musgrave Woodman read a paper before the Laryngological Section of the Royal Society of Medicine, in which he presented a modification of the Moure operation and reported several cases. In discussing various procedures that have been suggested, he referred to the cautery method of New as "crude and primitive," and made the remark that "the hot poker had been used in the days of Celsus." At this time a number of other members reported cases of various forms of antral malignancy. Thus, A. J. Hutchinson described a case

of endothelioma; F. C. Cleminson, a case of spindle cell sarcoma; Dan McKenzie, a case of endothelioma; Norman Patterson, one of columnar cell carcinoma; A. J. M. Wright, three cases of carcinoma involving the antrum and ethmoid. In summing up the various expressions of opinion, the president, William Mulligan, stated that the members as a whole favored tying the carotid; the general opinion was that these growths did not extend into the frontal sinus, though pyogenic infection of that sinus was common. It was the consensus of opinion that Moure's lateral rhinotomy did not give as good a view as the combined Killian and Ferguson operations.

Carter, after reviewing the literature of the subject since 1898, says: "The mortality shown by clinical reports is frightful, and all methods are apparently unsatisfactory, though it would seem that radium in conjunction with operative measures should be the choice of treatment."

In summarizing the subject of treatment of these growths, he writes: "The most successful treatment is a combination of surgery and the skillful use of radium. The methods in vogue at the present time which have yielded favorable results may be grouped as follows: (1) Anteoperative radiation, followed by surgical removal and postoperative radiation; (2) radiation alone, either as a palliative measure or because the risk from operative removal is too great, on account of the extent of the growth or the age and physical condition of the patient."

In the cases of malignancy of the antrum coming under the writer's observation, the use of radium alone has proved of little value. Within the past two years two elderly Jewish women with carcinoma of the antrum, who refused operative treatment, had radium applied by an experienced man. This agent did not seem to check the progress of the disease, nor were the chief symptoms, nose block, hemorrhages and facial swelling, lessened. The malignant process soon involved the ethmoid sinuses and orbit, and both patients succumbed within eight months of their first visit.

In two other cases of carcinoma of the antrum, wide resection of the maxilla and irradiation, beginning two weeks after the operation, has been effective in prolonging life. One of these patients, a woman, aged 60, and the other, a man, aged

53, lived in comfort for a year and a half, when the woman died from some obscure chest condition, thought to be a malignancy, while the man died from acute intestinal block.

A man, aged 55, with sarcoma of the antrum, came under observation ten years ago. His chief complaint was pain and a sensation of fullness in the region of the antrum. The pain was definitely limited to the antrum. Two molar teeth had been extracted. The patient was seen in the early stage of the disease. A much less extensive resection of the maxilla was performed than in the cases above cited. The patient was apparently cured, as he lived for three years and died of typhoid fever.

In the cases of carcinoma, nose block and hemorrhage were noted as the first symptoms. One of the patients came for the removal of polypi, and stated that polypoid growths had been removed a year previously. This was the only one of these cases in which there was a history of nasal trouble of any kind. In the case of sarcoma, pain was the only symptom of which the patient complained.

The writer's observations of Dr. Gordon B. New's methods of operation and irradiation and the results he has obtained lead him to believe that this is the best form of treatment for malignancy of the antrum available at the present time.

A fairly thorough review of the literature has left the writer with the rather convincing impression that malignant neoplasms of the antrum are by no means as rare as they have been supposed to be. It is, therefore, highly important that the rhinologist, the dentist and other practitioners dealing with this region should bear in mind the possibility of malignancy and should endeavor by all available means to recognize it before the process has advanced to the hopeless stage.

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LXVII.

DISEASE OF THE ETHMOID LABYRINTH.

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The object of this article is to show how disease of the ethmoid labyrinth is associated with (1) other nasal sinus disease, (2) deviation of the nasal septum, (3) headaches, (4) chronic deafness, (5) tonsillar infections, (6) dental infections, (7) orbital infections, (8) ocular disease, (9) intracranial complications, and (10) asthma.

ANATOMY.

It is necessary to review the anatomy of this structure as it is found in the normal adult, and to show variations from the normal during its development in infancy and childhood. The ethmoid bone lies in front of the sphenoid and between the orbital plates of the frontal bone. Its outer walls help to form the inner walls of the orbit. The ethmoid may be said to consist of three parts, viz.: (1) lateral masses, (2) a vertical plate and (3) a cribriform plate. The two lateral masses are made up of air cells with thin walls and turbinates. These are united above by the cribriform plate, which lies in a plane at right angles to them. The vertical plate hangs between the lateral masses and forms the upper portion of the nasal septum. A prolongation upward of this vertical plate forms the crista galli, to which the falx cerebri is attached. The lateral masses hang on each side and form part of the outer wall of the nasal cavity. Each lateral mass is wedge shaped, with the base attached to the cribriform plate, apex downward, and the long axis is anteroposterior; the whole of which is honeycombed with air cells.

On the mesial surfaces we have two and sometimes three turbinates. If there are two turbinates, there are two meati, the middle and the superior meati, but if there is a third turbinate, the space under it is called the supreme meatus. In the

superior meati are the openings through which drain the posterior ethmoid cells and the sphenoid sinus.

The ethmoid cells are divided into two groups: (1) anterior and (2) posterior. The third basal lamella, which corresponds to the attachment of the middle turbinate, divides the anterior from the posterior cells. The anterior group drain into the middle meatus, or below and in front of the middle turbinate. The posterior cells drain back of and above the middle turbinate. There are usually three anterior and four posterior cells on each side. (Piersol.¹)

Curran,² in his dissection of fourteen infant heads, found about the same number and arrangement of cells as in the adult. He further states he found the same number and arrangement in a fetus of three and one-half months, one of four months, and one of five months, and one of six and seven months.

The ethmoid cells are not always confined to the ethmoid bone, but frequently extend beyond the confines of the ethmoid capsule into the frontal, sphenoid, maxillary or into the middle turbinate.

Dehiscences.—Congenital defects have long been noted in certain portions of the ethmoid capsule, as in the lamina papyracea, os planum, etc. Schaeffer³ has examined a number of specimens in which the mucous membrane of ethmoid cells was in actual contact with the dura mater. In other specimens the mucous membrane of the anterior ethmoid cells was found in actual contact with the lacrimal sac. From this it is obvious how infection from the ethmoid may spread to the meninges and orbital tissues.

In another way, Turner⁴ describes these anomalies: "The ethmoid labyrinth in juxtaposition to the orbit, and separated from it by a thin osseous partition, sometimes perforated by congenital defects, and through which venous channels communicate with the ophthalmic veins, is a possible source of orbital infection, and, indirectly, may be the starting point of thrombosis of the cavernous sinus. Further, through its central position in relation to the other sinuses and its extensions into the bones with which it articulates, the suppurating ethmoid cells may infect the neighboring air spaces as a result of the destruction of the partition walls."

Blood and Nerve Supply.—The ethmoid obtains its blood supply from the superior branch of the sphenopalatine, and the anterior and posterior ethmoid arteries of the ophthalmic. The veins of the ethmoid are continuous with the ophthalmic veins; the latter empty into the cavernous sinus. Nerve supply in a large part is from the second division of the fifth, through the sphenopalatine ganglion. The anterior ethmoid nerve, a branch of the first division of the fifth, supplies some of the anterior ethmoid cells.

OTHER SINUSES.

It may be said that the ethmoid labyrinth is the connecting link between all nasal sinus disease. It is situated in the lateral nasal wall and overlaps all the other sinuses. Its infection affords a suitable source of contamination for its neighbors. Its walls are so thin that infection may travel by direct continuity.

The swollen ethmoid tends to block the outlet to every other sinus of the nose, by its contact with the nasal septum. The middle turbinate, usually affected with the same inflammation, becomes edematous and further helps to close the openings to the anterior ethmoid cells, the antrum and frontal, which are situated underneath it. This causes a stagnation and non-aeration in these sinuses, with the consequence of pent up infection.

It is not unusual to see the sphenoethmoid recess almost obliterated by a bulging posterior ethmoid or septal deviation in that region; drainage and aeration impaired and infection as the result.

The ethmoid may be the means of transferring a dental infection of the antrum to any one or all the other nasal sinuses.

Tribble⁵ reports a case of pansinusitis with cerebral abscess going from the antrum to the ethmoid, then to the frontal, then extradural abscess and meningitis.

NASAL SEPTUM.

The nasal septum plays an important rôle in ethmoid disease. Deviation of the septum or a thickened septum in the region of the middle turbinate is especially likely to cause obstruction of the anterior group of ethmoid cells, frontal and maxillary

sinuses. This produces a narrowing of the nasal space, and with very slight colds, obstruction occurs. Recurrence of colds often results in a chronic inflammation with a possible empyema of the cells. Resection of the nasal septum is a simple means of relieving ethmoid obstruction. This simple operation will often give relief. Reduction of the deformities of the septum is often necessary before the ethmoid and sphenoid sinuses are accessible for operative procedure. A deviation produces a slitlike nasal space on one side and increases the space on the other. The turbinates atrophy on the narrow side from being pressed back by the septum, while the increased space on the concave side allows excessive inhalation and frequently leads to hypertrophy of the overworked turbinates. This hypertrophy is compensatory; it is Nature's effort to warm the inspired air. This in time often produces a cystic degeneration of the enlarged turbinate and is another form of ethmoid disease, caused by deviation of the septum. Cystic middle turbinates, at least some portion of them, have to be removed with resection of the septum in an effort to equalize the nasal spaces. The atrophic turbinates are inclined to assume a suitable size when the narrow spaces are made wider. (Pratt.⁶)

HEADACHES.

Headache from ethmoid inflammation is felt particularly in the parietal region. This pain may extend to the temporal region. This is a sensation of dull pressure more than acute pain. The scalp may remain sensitive over these areas after the pain has subsided. Pain will be more pronounced on the side most affected. Intraorbital pain is complained of more in acute inflammation and when present is pathognomonic. (Skillern.⁷) Green⁸ says pain may be caused by four conditions: (1) acute inflammation, (2) chronic inflammation, (3) deformities of the nasal cavity with pressure, and (4) new growths. Headache from acute inflammation has distinct characteristics in that it is inclined to occur at a certain interval after arising in the morning and to wear away about noon or the middle of the afternoon each day. This pain will increase in its intensity until a peak is reached after a few days. Then it is inclined to grow less severe each day until it dis-

appears. This type of pain is aggravated by stooping and bodily exertion.

Pain in chronic inflammation of the ethmoid may be of little import, or it may be pain referred over any or all of the branches of the nasal ganglion. Septal deviations, thickening of the nasal septum in its upper part, enlarged or cystic middle turbinates, causing contact points, are sources of pain which usually will be relieved by surgical procedure. New growths, polypi, fibromas and malignant disease of the sphenothmoid region and nasopharynx are a source of cranial neuralgias. Sluder⁹ describes the symptoms of nasal ganglion syndrome as pain occurring in the side of the face, teeth, occiput and neck, shoulder, arm and even in the tips of the fingers. He says mild cases are described as a sense of tension in the face and rheumatism in the neck and shoulder. Diagnosis can often be verified by anesthetizing the ganglion with a watery solution of cocain. Repeated daily applications will sometimes result in permanent relief.

CHRONIC DEAFNESS.

Ballinger¹⁰ says, "Ethmoiditis and sphenoiditis are fruitful sources of middle ear inflammation. The morbid secretions from these cells flow into the epipharynx and excite an inflammation which in time extends by continuity of tissue to the eustachian tube and middle ear."

Babbit¹¹ has recently reported improvement in catarrhal deafness by operations on the septum and ethmoid on the same side as the ear affected. Fraser¹² concludes that in cases where the hearing distance is improved by inflation, operations for the removal of polypi and other nasal defects may be expected to be of benefit. On the other hand, he mentions it is not unusual to find a nose full of polypi and a marked deviation of the septum in which hearing is unimpaired.

TONSILLAR INFECTIONS.

Most otolaryngologists will testify to the fact that catarrhal conditions of the nose in the adult will, as a rule, improve after infected tonsils are removed. Definite facts are not established by reports in this respect. Dean's¹³ report is most conclusive in regard to sinus infection in children. He states

that 80 per cent of nasal sinus infections in infants and children are relieved by removal of infected tonsils and adenoids. These results he attributes to the age of the patient, excluding long chronicity, and to comparative infrequency of nasal obstructive lesions in infancy and early childhood. He believes in the procedure so firmly that even though pus is present in the sinuses, he attends to the throat condition and awaits results. He has the patient return in a few months for examination before the nasal condition receives further treatment.

DENTAL INFECTIONS.

It is probable that ethmoid infections are usually secondary to dental infections, the usual course being by way of the maxillary sinus. Cahn¹⁴ says purulent discharge in the nose is often due to infected upper anterior teeth. Fistulous tracts may be present, extending from a tooth into the nasal cavity, and discharging therein. He mentions a case in which a nasal discharge ceased after the extraction of an upper tooth. He says 25 per cent of chronic empyemas of the antrum are of dental origin. This has a secondary influence on the middle turbinate and ethmoid, which are continually bathed in this purulent secretion emptying under the middle turbinate on the side affected.

ORBITAL INFECTIONS.

When ethmoid infection extends into the orbital issue, edema of the eyelid on the nasal side is the first sign that the inflammatory process has extended into the orbit. This is followed by a chemosis of the conjunctiva, outward displacement of the globe, proptosis and diplopia.

Posey¹⁵ quotes Birch-Hirschfeld¹⁶ as follows: "Of the 409 cases of orbital inflammation following sinus infection, 83 showed involvement of the ethmoid cells. In almost all cases he found a sinus empyema, which had followed rhinitis, influenza, pneumonia, scarlet fever and diphtheria, or after traumatism."

In Holmes¹⁷ translation of Birch-Hirschfeld:¹⁸ "The extension of the inflammation to the orbit depends upon the local periostitis of the orbital walls, there being certain points

of predilection. The infection usually follows the course of the perforating vessels."

The orbital periosteum often offers sufficient resistance to the inflammatory process to prevent its extension to the orbital contents, and the abscess remaining subperiosteal may extend forward, or backward into the orbit, causing an inflammation of the optic nerve, or, if forward, evacuate itself spontaneously at the orbital margin.

In other cases the inflammation extends early to the orbital contents through a thrombophlebitis. These case are more difficult to diagnose.

In addition to the circumscribed areas on the orbital walls tender to pressure, the direction of the dislocation of the globe is of diagnostic value.

Contraction of the visual field is rare.

Of great importance as an aid in diagnosis in inflammation of the posterior sinus is the discovery of a central scotoma."

In recent years a great many orbital infections from ethmoid diseases have been reported. Roberts and Harris¹⁹ report a case of a boy, age 16; Ira Frank,²⁰ one in a boy, age 19; Phelps,²¹ ten cases, all under 12 years of age; Siegmeister,²² five, all under 11 years of age; Fenton,²³ two, in boys 11 and 12 years of age, following swimming; Vanderhoof²⁴ reports an orbital abscess in a man, 45 years of age, which ruptured externally, but was cured by operating on the ethmoid cells; Jones,²⁵ three cases of orbital infection, two of which were boys 16 and 19, following acute colds; one, a boy of 16, following swimming; Gittens,²⁶ three cases, one in an infant and two in children 3 and 12 years of age. The writer has had two cases of orbital infection, as follows:

Case 1.—A boy, 8 years of age, the next day after swimming in a stagnant pond, developed a purulent rhinitis with very offensive odor, and complete nasal obstruction. Eyes were completely closed, with edema of both lids. There was a diffuse inflammation of both orbits. Treatment: Nasal spray of one-half per cent cocain solution, followed by warm salt nasal irrigations and hot boric stupes over the eyelids. Complete resolution in three days.

Case 2.—A girl, 11 years of age, with "grippy" cold, suddenly developed swelling over inner angle of left orbit. Swell-

ing showed fluctuation at first examination. Diagnosis: Orbital abscess. Drainage was made by simple incision over swelling with evacuation of considerable yellow pus. This pus cavity was continuous with an anterior ethmoid cell, which was opened into the nose at time of operation. Recovery in one week.

OCULAR DISEASE.

The posterior ethmoid cells and sphenoid sinus are in immediate relationship to the posterior half of the medial wall of the orbit, and to the superior orbital fissure and optic foramen. On account of this anatomic relationship, infection in these cells may be associated with optic neuritis, optic atrophy and paralysis of the ocular muscles. In the absence of ophthalmic changes, central scotoma and contraction of the field of vision, especially for colors, are signs which should suggest nasal disease. A careful examination of the nasal sinuses for infection should follow in every case in which these signs are present. (Turner.²⁷)

Caldwell,²⁸ in 1893, reported two cases of loss of vision from sinus disease. Case 1.—Female, age 19, with blurred vision and intraorbital pain. Inspissated secretions from both middle turbinates. Source of pus was found to be in the anterior ethmoid cells. Eye symptoms and nasal discharge disappeared under treatment. Case 2.—Male, aged 37, with purulent nasal discharge. Intermittent intraorbital pain and blurred vision were present. Soon after, became suddenly blind. Necrosing and cystic ethmoids were found on both sides. Removal of middle turbinates brought about good nasal drainage, and general well being. Loss of vision was permanent. Conclusions: Blindness caused by suppuration of the ethmoids.

Halstead²⁹ (1901) mentions a case of sudden blindness in which there was empyema of the maxillary, ethmoid and sphenoid of the opposite side. Vision was restored after draining these sinuses.

Packard³⁰ (1907) reported nine cases of marked visual disturbance. Distinct ethmoid disease was noted in each case. Conservative treatment was used in five; part, or all, of the middle turbinates were removed in four. Complete recovery was obtained in six and marked improvement in three.

Sluder³¹ (1907) draws attention to a case of a young man who suffered pain in his right eye three days. Orbital swelling appeared on fourth day. Twelve hours later he became blind in both eyes. Left eye remained so only twenty-five minutes. Superior meatus of nose was swollen shut. Recovery of sight was obtained following nasal shrinkage and other medication.

Thompson³² (1907) cites a case in a woman, aged 40, which began with pain in left eye and temple. Ptosis, mydriasis and divergence were present. Necrosis of left ethmoid was found. Curetment of left ethmoid brought about recovery. Another case is that of a practicing physician who had la grippe ten days, in which he developed diplopia, divergence and mydriasis. Large middle turbinates were found in contact with the septum. Middle turbinectomy and opening anterior ethmoid cells brought recovery.

Onodi³³ (1908) made a very extensive report of his work on the relation of the optic nerve to nasal sinus disease. In this he says, "For ten years I have been investigating the more delicate construction of the nasal cavities and relation of the optic nerve to them. Our observations have shown that the wall between the last ethmoid cell and the canalis opticus and sulcus opticus is nearly always as thin as tissue paper. We have often found a thicker section between the sphenoid sinus and the canalis opticus and the sulcus opticus."

His work formed an anatomic basis for the theory of blindness from nasal accessory sinus disease. In his report he cites some thirteen cases of unilateral optic neuritis which were relieved by treatment or by operation on the posterior ethmoid cells on the same side, and one example of bilateral blindness with suppuration of the left sphenoid and right posterior ethmoid cells, which was cured by operation on these cavities. Another bilateral case with infection of all posterior sinuses was relieved by operation of posterior ethmoids and sphenoids. One case was cured by medical treatment of one month.

White³⁴ (1920 to 1922) reported thirty cases of blindness from combined ethmoid and sphenoid disease. Twenty-nine of these were operated upon. Operative measures consisted of removal of the middle turbinates and opening the sphenoid in all; uncapping the posterior ethmoids in addition, in six-

teen. Eleven of the above had normal vision; three showed good improvement; two recovered nearly normal vision by local treatment. He (1923) advanced the theory that injury to the optic nerve not only comes from infection, but pressure atrophy may occur by the tissues becoming thickened with inflammation in the bony optic canal. He says the size and shape of the optic canal plays a good part in this constriction. The optic canal varies from 4 mm. to 6 mm. in diameter. This variation in size he has been able to measure by X-ray and fluoroscopic examinations. Very slight swelling in a canal of smaller dimension will cause pressure atrophy to the nerve much sooner than where the bony canal is larger.

Three cases of loss of vision are mentioned by Holmes,³⁵ in which he found the middle turbinate wedged in against the septum. Removal of the middle turbinate on the side affected was that all was necessary for a cure. One of these also had an empyema of the sphenoid, which was drained.

Lorie and Lichtenberg³⁶ (1920) reported a series of eight cases of blindness in which they had all degrees and grades of symptoms, from slight asthenopia to complete blindness. They state many of these patients are such that go from one physician to another for supposed errors of refraction or muscular imbalance. These patients may show no ophthalmoscopic changes to those of marked intraocular changes. Ethmoid disease was noted in all their cases. All but one improved following operation on the ethmoid.

Vail³⁷ (1920) mentions a case of third nerve palsy from ethmoid empyema. Ptosis, exophthalmos, divergence and partial mydriasis were present. Cure was obtained by intranasal ethmoid exenteration.

INTRACRANIAL COMPLICATIONS

Intracranial infection may travel through the wall of the affected sinus or indirectly by way of the orbit. This may be on account of disease of the bony wall of the sinus or through intercommunicating veins between the sinus and meninges, or through the lymphatics. When infection goes from the ethmoid to the orbit it is then carried by the ophthalmic veins to the cavernous sinus.

Myers³⁸ contends that every opening in the skull through which nerves and blood vessels pass is a potential pathway for infection to enter the cranial cavity. The anterior ethmoid vein communicates with the dural spaces and meninges of the frontal lobe. The other ethmoid veins empty into the ophthalmic veins. Cavernous sinus thrombosis is the classical complication of ethmoid disease.

Eagleton³⁹ says ethmoid infection is not a very frequent cause of intracranial complication. This is true despite the fact the ethmoid is a frequent site of surgical procedure. This immunity is because the nutritional supply of the superior surface of the ethmoid bone is not easily disturbed. Necrosis of the roof of the ethmoid is rare.

The nose affords a great protection to the upper respiratory tract and brain. By its ciliated epithelium, mucous glands and adherent tunica propria, it adequately prevents the invasion of the bone by repeated infections within the nose and sinuses.

Brain infection by way of lamina papyracea and orbit is the most frequent route. In this way ethmoid infection causes about 12 per cent of frontal lobe abscesses. In 140 reported cases of frontal lobe abscess, he claims 23 had distinct ethmoid origin. Other cases obtained from the literature are as follows:

McCaw⁴⁰ mentions a case in a man, 40 years of age. Edema of the lids and delirium were present; high deviation of the septum to the left with polypi and pus in left ethmoid; subperiosteal abscess in left temporal region coming from orbit; infection at same time going backward along sphenoid fissure to meninges.

Bosworth⁴¹ mentions a case in a dentist, 33 years of age, who gave a history of nasal discharge on left side of nose for years and on the right side for the past three months. He was taken suddenly ill with pain in left side of face and head. Dry pus was found in the left side of the nose, with white pus under the left middle turbinate. Ethmoid cells were necrosing. Ethmoid and sphenoid were opened. Chills occurred ten days following the operation, with high fever, semiconsciousness, paralysis of the left side of face and death in twenty-four hours.

Four cases of cavernous sinus thrombosis from ethmoid disease were reported from 50,000 case records of Johns Hopkins Hospital.⁴²

Rodger⁴³ cites a case in a boy, 14 years old, with swelling over left eye, chemosis of conjunctiva and paralysis of the left external rectus muscle. Left frontal, ethmoid and antrum were found infected extending to cavernous sinus.

Smith⁴⁴ reports five cases, one of which was of ethmoid origin. Right ethmoid was the seat of the infection. Patient had chills and high fever for several days, then headache and meningeal symptoms began. Swelling of the right eye, soon followed by swelling of the left. Exophthalmos, chemosis of conjunctiva, immobile globes and mydriasis were present.

ASTHMA.

St. Clair Thomson⁴⁵ states that cases of asthma which did not begin in childhood may be benefited by ethmoid surgery. In cases where polypi are present, or where there is polypoid denegeration of the ethmoid, these conditions can be cleared away with good prospects of considerable and even lasting relief.

Shambaugh⁴⁶ says hyperplastic ethmoiditis is the pathologic condition of the nose usually associated with asthma. Its connection has a very decided influence in most cases. Anatomic defects which tend to interfere with normal ventilation of the ethmoid, as high deviation of the septum, may be the cause of the hyperplastic ethmoiditis. Some cases of asthma are permanently cured by exenteration of the ethmoids. When cure is not obtained there may be a focus of infection in the frontal or maxillary sinus. These sinuses will need drainage before a cure of the dependent ethmoid can be expected.

Tod's⁴⁷ report, taken from the records of the Ear, Nose and Throat Department of the Royal Infirmary, is conclusive. This information was obtained by sending out questionnaires to people who had undergone nose and throat operations for the relief of asthma. Cures from turbinotomy were given as 11 per cent; from polypi removed, were given as 12 per cent.

Sluder⁴⁸ reports relief in a case of asthma of ten years' standing, by injection of the sphenopalatine ganglion with 5 per cent phenol in alcohol.

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LXVIII.

TONSIL INFECTION, WITH REPORT OF CASES.*

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BEATRICE, NEB.

While tonsillectomy is perhaps the most frequently performed operation in this country and the literature on the subject is voluminous, we attempt with some temerity to add to it. From a perusal of the literature it would appear that everything of any possible consequence has already been written. We are of the opinion that tonsillar infection is fraught with some danger that is not always apparent. We confess to attributing some remote pathology to incidence of infection in the tonsils, which cannot always be proven. Until we know definitely and exactly the function or functions of the tonsil, there will probably be much difference of opinion. There are several rather tenable theories, all of which hold some reasonable material. Quoting from Proetz, "Fortunately, we are not constrained to accept one of these theories, discarding the others. When our understanding of the tonsil finally crystallizes, it will, no doubt, include germs of truth from each, which have heretofore wanted correlating. If we epitomize our knowledge of the tonsils as it stands today, we are bound to admit that it behaves remarkably like other lymph glands of the body, and that the mucous membrane which covers it shares all its attributes with the rest of the oral mucous membrane."

In this paper we will not take up the bacteriology or microscopic pathology, as this has been very elaborately worked out by various writers. We will confine ourselves chiefly to clinical observations.

INDICATIONS FOR OPERATION.

1. Recurrent sore throat.
2. Obstruction to respiration, both nasal and oral.
3. Recurrent peritonsillar abscess.

*Candidate's thesis for the American Laryngological, Rhinological and Otological Society.

4. Removal of tonsils as a therapeutic measure for infectious arthritis.
5. Removal of tonsils as a therapeutic measure for rheumatoid arthritis.
6. Removal of tonsils as a therapeutic measure for myalgia, myositis and neuritis.
7. Removal of tonsils as a therapeutic measure for acute rheumatic fever.
8. Chorea.
9. Nephritis, acute and chronic.
10. Acute iritis, recurrent iritis, corneal ulcers, episcleritis.
11. Infected and enlarged cervical glands.
12. Chronic catarrhal otitis media.
13. Acute catarrhal and suppurative otitis media and mastoiditis.
14. Removal of the tonsils as a therapeutic measure in goiter.
 - (a) Simple goiter.
 - (b) Adenomatous goiter.
 - (c) Toxic goiter.
15. Removal of tonsils in the effort to control diphtheria carriers.
16. Removal of tonsils to control Vincent's angina.
17. Removal to mitigate or help control the incidence of head colds, catarrh and nasal sinus disease.
18. Removal of tonsils as a therapeutic measure in hypertension.
19. Removal of tonsils as a therapeutic measure in gastrointestinal disease.
20. Cardiac disease.
21. Ovarian cystic disease.
22. Asthma and chronic cough.
23. Pulmonary tuberculosis.
24. Headache.
25. Recurrent laryngitis, apparently of nontuberculous origin.
26. Malnutrition in children.
27. Retrobulbar neuritis.
28. Acute and chronic peritonsillar abscess.

In a great many of the above enumerated indications, the theory of focal infection and the effect of a nidus of infection

or infections, pathology or symptoms of some distant part of the body may appear to have been overdrawn. We take the stand that any procedure which alleviates suffering or has a reasonable chance to enhance or augment the general systemic resistance is good therapy. Many of our cases underwent several surgical procedures in addition to tonsillectomy for the same indication. Practically all of our cases had the usual medical and physical therapeutic agencies applied, in addition to as far as possible eliminating all foci of infection. In a few cases removal of tonsils, followed by a few days of salicylate therapy only, was used. In so far as possible, we will try to portray results in these cases.

PREOPERATIVE PREPARATION.

Some of our patients received no preoperative regime whatever, and were immediately operated upon. We deprecate this practice and do not advocate it. However, under the exigencies of referred work it is at times necessary. As a rule, they had been examined elsewhere and we had verbal or written reports from the referring doctors.

When patients are under our control so that a routine can be carried out, we advise the following procedure, which is not very detailed and embraces a minimum of effort and expense:

Avoid operation during the course of acute throat, anginal or respiratory infections.

General physical examination, noting especially condition of heart, lungs and cardiovascular system. We take the stand that with a given definite indication, probably very few conditions are absolute and definite contraindications to a tonsillectomy. If the operator knows the physical defects and infirmities of his patient, being forewarned, he is in a better position to forestall accidents.

Sixty grains of calcium lactate are given the day before operation.

Blood coagulation time taken just prior to operation.

Eat as usual the day before operation. Those patients who are operated upon under a local anesthetic are permitted a light breakfast. We have found less tendency to nausea and less

gagging on the part of the patient if he has partaken of a light meal before a local tonsillectomy.

Patients operated upon with a general anesthetic are given no breakfast or liquids before operation. They are advised to enter the hospital the night before operation, as the preanesthesia arrangements can be then better carried out. However, in our territory this has not been the custom, and most of the patients who are given general anesthesia are children, and the parents object to this and, as a matter of fact, most of them report at the hospital on the morning of operation, and many of them after a ride of several miles. This, we feel, is not treating the patient exactly right, but to date we have had no accident or serious complications which we could directly trace to this fact. We have noted, however, that these patients take more ether to anesthetize and usually display more coughing and pharyngeal irritation to the ether.

Ether is the general anesthetic of choice. We use chloroform preferably in asthmatic children and in children with peribronchial lymphadenitis.

We advise local anesthetic as a routine in adults, but do give a general anesthetic in cases where there are no contraindications of moment.

As a local anesthetic we use $1\frac{1}{2}$ procain solution, to which is added one drop of 1/1000 adrenalin chlorid solution per dram of procain solution. We use from 3 to 4 drams of the solution as a peritonsillar infiltration for each tonsil. Adults are given a preliminary hypodermic of morphin sulphate, grains 1/6, and atropin sulphate, grains 1/150, one-half hour prior to entrance to the operating room. We much favor the preliminary hypodermic, as it allays nervousness and tension in most patients and reduces the sensibility of the pharynx while doing the injection. The hypodermic renders some patients nauseated as soon as they sit up or move around, but this is a rather small percentage of the total.

TECHNIC OF OPERATION.

We attempt to do a complete operation in all cases. We employ dissection, using knife, scissors and snare. The same method is used in both local and general anesthesia. In se-

lected cases a modified Sluder technic is used on the patients given a general anesthetic. No advantage is claimed for the latter method.

We use all ordinary precautions to prevent infection and accidents, and are as fastidious as is consistent with practical methods of surgery. While we realize aseptic surgery is impossible in the throat, we believe care and attention to technic reduce postoperative infection. We can, at least, be certain that a minimum amount of external contamination of the operative wound occurs. Those cases operated upon under ether have the pillars and lines of incision touched gently with tr. iodin just prior to beginning the dissection. In both local and general cases the fossæ and pillars are touched with tr. iodin following the completion of the operation.

In the endeavor to prevent unnecessary loss of blood, we tie off vessels as they are encountered or immediately after completion of the dissection. For this purpose we have tried various suture materials, but during the past four years have used almost exclusively number one iodized catgut. For general use it has seemed to meet almost all requirements. In special cases we have resorted to heavy braided silk.

The blood supply of the tonsil (quoting from Johns Hopkins Hospital Bulletin, Vol. XXVII, No. 311, January, 1917) is derived from the following sources:

1. The tonsillar ramus of the external maxillary artery. It is important to remember that the main trunk of the external maxillary artery, after leaving the external carotid, may take a decided upward bend before it passes around the ramus of the jaw. The loop thus formed comes in close relation to the inferior portion of the tonsil, and in removing a tonsil this large artery may be cut unless the field of operation is kept dry and the dissection made as close as possible to the capsule.

2. A large branch of the lingual artery enters near the inferior extremity of the tonsil behind. In order to do a complete tonsillectomy we have found it necessary to ligate this vessel in every case, both in adults and children. (We have not had this experience in all cases, although in the main we agree.)

3. The upper portion of the tonsil is supplied by one of the pharyngeal rami of the ascending pharyngeal artery and by

the descending palatine artery, a branch of the internal maxillary.

The blood supply, as given by Dr. Sluder after Fetterolf, differs slightly but in the main is the same. He makes one very poignant deduction, "as regards a single ultimate source, they all receive their blood from the external carotid, and this is, therefore, as is well known, the artery which would need to be ligated. It bifurcates at the upper margin of the thyroid cartilage. The internal carotid is one-half inch lateral and three-fourths of an inch posterior to the tonsil." We have never had occasion to ligate the external carotid on account of tonsillar hemorrhage.

Most cases of hemorrhage during operation can be controlled by ligature, but in some cases, where it was not possible or practicable to pick up the vessel and ligate it, we have resorted to putting a plug of gauze between the pillars and holding it in situ with ligatures through the pillars. Pressure with a pad of gauze on a hemostat will frequently control bleeding so that the bleeding vessel may be picked up and ligated.

CONTRAINDICATIONS TO TONSIL REMOVAL.

One of the absolute contraindications would be hemophilia. The only manner of detecting these people is by a careful history and the determination of the clotting time of the blood. We do not presume any surgeon would attempt a tonsillectomy on a known and proven hemophiliac.

Avoid tonsillectomy during the acute throat and tonsillar infections. To our minds this makes tonsillectomy inadvisable during the acute exanthemata. There is some strong argument, such as that of Dr. Frederick T. Clark and Thomas and Wolfe, that in certain selected cases tonsillectomy during acute infections is not only justifiable but advantageous. We do not condemn the procedure entirely, but would take a rather conservative viewpoint and contend that in the interest of safety and avoidance of complications, we would much prefer to operate when acute local inflammation is not present.

In general, advanced cardiorenal disease or general debilitated states, where the patient is at a very low ebb, are contraindications to tonsillectomy, unless there is a very reasonable

probability of some immediate comfort and relief from the procedure.

Status lymphaticus and enlarged thymus are very definite contraindications.

There are a great number of theoretic and unproven contraindications, only two of which we will mention. One is the internal secretory function of the tonsil, and the other the theory of hematopoiesis. There is much room here for theory and argument, but, so far as we can find in the literature, nothing very definite is known.

POSTOPERATIVE TREATMENT.

To our minds, the most important postoperative procedure is rest in bed, and preferably in a hospital, until the patient feels like being about and can do so comfortably. We advise most of our patients to remain at the hospital for 48 hours following operation. The majority, however, leave the hospital 24 hours following operation. Those whose condition indicates it are kept until we feel they are safe to dismiss. All patients on dismissal from the hospital are given a printed slip with directions as follows:

1. Keep quiet for two or three days.
2. Diet: Milk, soup, broths, milk toast, ice cream, breakfast food, custards, or any soft foods which do not hurt the throat.
3. If ears ache, use hot water bottle.
4. Use cold compress on throat if it relieves.
5. Beginning the day following the operation, use a mouth wash of one-third teaspoonful of salt to a glass of warm water. Do not gargle if the throat is too sore.
6. Take a mild cathartic the morning following operation.
7. Take an aspirin tablet 30 minutes before eating; place it on the tongue and let it fall to pieces or crush it up in tablespoonful of water and sip slowly. (This for adults. Under ten years of age, dosage reduced.)
8. It is not very often that one bleeds from a tonsil operation but at times it does occur. If the patient should happen to bleed there are two or three things which should be done.
 - (a) Do not get excited.
 - (b) Keep patient quiet; have him lie on side so he can spit the blood out with the least possible effort.

(c) Put a cold compress about the throat and on back of neck.

(d) If it is at all severe, call your nearest doctor.

(e) If he thinks it is serious and he wants help, have him call us.

Patients who live near are invited to return for local inspection and observation daily at the office for a week or ten days. In those patients who are adults we usually touch up the pillars and fossæ with a mixture of 1 part guaiacol in 3 parts olive oil. Most of them seem to appreciate it and claim it gives temporary relief. No local application is attempted in small children, as it usually angers and makes them resentful.

The age of patients operated upon varied widely. The youngest was a child of 8 months, in which tonsils and adenoids were removed on account of obstruction to respiration and deglutition. The oldest patient in whom tonsils were removed was 81, and the indication in this case was recurrent peritonsillar abscess. He stood the operation as well as a youngster and has been grateful for the relief it afforded.

We hesitate to advise removal of tonsils of a child under 2 years of age. But where the indications are definite, we see no valid reason why age, per se, should be considered.

POSTOPERATIVE COMPLICATIONS.

In 2,530 cases we have encountered the following post-operative troubles:

H. F., age 9, reported at the hospital on August 11, 1926, for operation. She was a healthy appearing, well developed girl. The chief complaint was nasal obstruction of six years' duration. Obstruction not complete, but partial and alternating. Always had breathed through mouth at night. History of frequent head colds during winter months. History of only occasional and slight tonsillitis. General health good. Physical examination showed a large mass of central adenoids. Tonsils of medium size, partially submerged. Pus and caseous material from tonsillar crypts on pressure. Teeth and gums normal. Otherwise general physical condition normal. Tonsil and adenoids removed under ether about 9 a. m. No complications met on operating table and patient went to her room in good condition. Postoperative condition normal and un-

eventful until 7 p. m., when we were notified that she was bleeding. Examination showed a moderate hemorrhage from the right adenoid region. As the patient was somewhat restless, she was removed from the ward to a private room and a special nurse put on the case. She was given 1/16 gr. morphin by hypo and 1 cc. fibrogen (Merrill) subcutaneously. Hemorrhage persisted, but was under control by 10 p. m., by pressure of small amount of gauze on a curved hemostat in nasopharynx. As soon as hemorrhage was under control, gauze was removed. Bleeding began again about 11 p. m., when a small pledget of gauze was saturated with oral fibrogen (Merrill) and inserted into nasopharynx by the catheter method. Bleeding stopped almost immediately. As the patient was somewhat restless, the postnasal pack was removed about midnight. Patient's temperature 102°, pulse 120. She appeared somewhat anemic from loss of blood but was not considered to be in an alarming condition. She drank water freely but vomited it from time to time. She fell asleep, and as her condition seemed to be as satisfactory as could be expected under the circumstances she was not further disturbed. At 3 a. m. the nurse telephoned that the patient was having a convulsion with the body in a rigid and extended position. Heat, hypodermic adrenalin and so on were administered by the nurses, but the patient had expired when we reached the hospital a few minutes later. Autopsy was not obtained. We concluded this patient died from an embolus, but of course in the absence of autopsy this is only conjecture. We are certain that it was not a death from hemorrhage, as we have had several patients who lost much more blood and had the general appearance of almost exsanguination but still recovered. It is a matter of conjecture as to whether the fibrogen used had any bearing on the death. Also the tolerance of a 10-year-old child to morphin is never definitely known, and this girl had a hypodermic of 1/16 grain morphin eight hours prior to her death. She showed no marked evidence of morphin poisoning. Some other factors, as persistent thymus, enter into the problem, but in the absence of autopsy we can only conjecture. A postoperative death in an apparently healthy child forces one to consider tonsil and adenoid removal as a major procedure. While it has been said there should be no operative

mortality, it does not preclude accidents, which may be serious and even fatal in their outcome.

We had another very severe postoperative complication. It was unusual and came near having a fatal outcome. Miss E. W., teacher, age 20, underwent local tonsillectomy February 25, 1924. No trouble at time of operation; patient left hospital and went to her home the day following operation. One week following operation she resumed her duties in the school room. That evening she reported at the office and was spitting up a little blood, which was coming from the fossæ, evidently where a scab had come off. The area was touched with Monsell's solution and bleeding stopped. We were called to her home early next morning on account of slight bleeding. Application of styptic again controlled bleeding. About two hours later we were again called, when bleeding from the throat was again under way, this time from each fossa, but slight—in fact, only enough to discolor saliva. However, while I was at the house she had a sudden call for the toilet, and the landlady helped her on a bed vessel, which the patient promptly filled with bright red blood from the bowel. It was bright red and not black at all. No evidence of clotting. Patient in extremis after passage of blood from bowel and sent to hospital in ambulance. Medical consultant called in tried to convince me that the blood passed by the bowel had been swallowed, but I have never agreed with him on this. The patient made a complete recovery. She had a gastrointestinal X-ray examination a few days following the hemorrhages, by an expert radiologist, and no ulcer or other pathologic area was found in the tract. Prior to the tonsil operation patient had submitted to appendectomy, removal of one tube and ovary and gall bladder. Our opinion has been that it was a hemorrhage from the gastrointestinal tract and probably of thrombotic, mesenteric origin, as some gastrointestinal hemorrhages have been explained following abdominal surgery, or in some cases where no surgery had been performed.

Another hemorrhage case is worthy of report in some detail. Mrs. M. K., age 50, came to local tonsillectomy, the chief indication being recurrent sore throat. Weight, 145 pounds. She gave a history of specific infection several years prior, and had had several years of intensive antisyphilitic treat-

ment. Blood Wassermann still 4 plus in spite of treatment. She suffered violent and intractable headaches, for which no direct cause could be found excepting an extremely high blood pressure, which ranged around 280 systolic. Blood coagulation time, five minutes. Local tonsillectomy performed in the usual manner, but before she was removed from the operating room a profuse hemorrhage began from each fossa. We were unable to ligate any points which in any way controlled the hemorrhage. Pressure was of little avail. Gauze packs impregnated with coagulose (Parke Davis) were placed in the tonsil fossæ and retained by silk sutures through the pillars, but did not in any wise seem to control the hemorrhage. In fact, the bleeding was profuse from the needle punctures through the pillars. As an estimate she lost fully three quarts of blood within an hour. When the patient seemed to be almost exsanguinated she fainted and bleeding stopped. It did not recur. She was kept in the hospital for ten days, at the end of which time the tonsil fossæ were practically healed. Blood pressure the day following operation was 140 systolic. For several weeks she claimed to be entirely free from headache. On leaving the hospital she resumed her occupation of collector. About five months following operation she suffered a cerebral hemorrhage, from which she expired after lingering along for ten weeks.

Postoperative bleeding from tonsil fossæ was observed in 30 cases, severe enough to require ligature or packing in the fossæ, with suture through pillars to hold pack in position. The majority of these hemorrhages occurred during the first 24 hours following operation.

Moderate hemorrhage occurred in 38 cases, but not severe enough to require more than rest, quiet and ice coil to throat and moderate pressure. As a rule, adults are given a full dose of morphin sulphate as soon as postoperative bleeding occurs, in order to reduce nervousness and to give them physical quiet.

Slight bleeding occurred in 32 cases, but not of sufficient severity to require any local treatment. No record was kept of the number of so-called reactionary hemorrhages which came on soon after operation. Those of any gravity whatever are included in the above reports.

Postoperative bleeding from the adenoid region was observed in 13 cases. One severe case on the ninth postoperative day was controlled by ligature under ether. Three other cases were controlled by a postnasal tampon. The other cases were of a very mild type and really required no local interference.

Postoperative pneumonia was observed in several cases. Two children, brother and sister, had tonsil and adenoid removal without accident. They were discharged from the hospital the next day, apparently in good condition. They went to their home town, about thirty miles away, and the local doctor reported that each child came down the third day following operation with a bronchopneumonia, from which they eventually recovered.

F. G., age 6, had tonsil and adenoid removal along with removal of five abscessed primary teeth by a dentist under ether on June 21, 1926. No trouble during stay at hospital, which was 48 hours. One week following operation patient had chill and came down with left lobar pneumonia. She later developed pleurisy with effusion, and was aspirated several times. Pus formed and patient was drained with tube between ribs about four weeks following operation. Good recovery.

C. C., age 5, had tonsil and adenoid removal under ether June 8, 1926. History of whooping cough three years prior to operation. Mucopurulent secretion in each nostril. Maxillary sinuses dark. Chest had been pronounced clear by family doctor. He made a normal operative recovery, and ten days following operation his mother reported that he had not coughed for several days. He came down with pneumonia, bilateral, thirteen days following operation. He succumbed within twenty-four hours of the initial chill. We do not consider this an operative death. The operation may have been a contributing factor, however, to his fatal pneumonia.

One case, a boy, H. S., age 8, had tonsil and adenoid removal under ether. He took the anesthetic poorly, and it was quite difficult to get him etherized. It afterward was discovered that he was coming down with whooping cough at the time of operation, but this had been overlooked. He had a rather stormy time for ten days, but made a complete recovery.

Paresis of the soft palate developed in two cases, both adults,

one of which was operated upon with a local anesthetic and the other under ether. They both lived at some distance and were not seen until the fossa was healed. The inference is that they had a postoperative diphtheritic infection, which in all probability would not have been picked up had they been nearer, as we do not make postoperative cultures as a routine. They both made complete recoveries. Postoperative throat cultures would probably show some low grade cases of infection by the diphtheria bacillus.

Acute laryngitis occurred following operation in four cases. Complete recovery.

Two cases of postoperative peritonsillar abscess were observed in the soft palate above and external to the tonsillar fossa. They were incised. We presume that infection was carried into this region by the needle, and in an endeavor to prevent this we now cleanse the needle with alcohol subsequent to each puncture.

One case of cellulitis of the neck of moderate severity followed removal of tonsils under local anesthesia, March 21, 1925. Miss F. J., age 19. Operation uneventful. The day following operation she had cellulitis of neck, bilateral, with marked swelling of anterior cervical glands. Heavy thick exudate in tonsil fossæ. Diphtheria antitoxin administered, 20,000 units. Culture was negative for diphtheria. The cellulitis gradually subsided under rest in bed and heat. Ten days later the maxillary sinuses were opened intranasally on account of a bilateral purulent sinusitis. The cellulitis and symptoms of sepsis again lighted up but receded in the course of two or three days, and she went along to recovery.

We have observed acute sinus infections following tonsillectomy. They all from the history seemed to be an acute lighting up of old infections.

Maxillary sinusitis.....	15 cases
Ethmoid sinusitis.....	3 cases
Sphenoid sinusitis	3 cases

They ran the usual course, but seemed to have been stirred up following the tonsillectomy.

On two different occasions a rather peculiar accident occurred. While severing the base of the tonsil with either scis-

sors or snare the tenaculum became disengaged from the tonsil and the patient swallowed his tonsil.

The uvula was removed in whole or in part, accidentally, in several cases. No untoward effects noted, except that it is a rather embarrassing accident to explain to the patient or parents.

The anterior pillar was buttonholed, nicked, injured or removed entirely in several cases. No untoward results were noted except that it is usually noticeable on close inspection and may leave an asymmetric appearance in the pharynx. No speech or singing defect noted. This, however, is not so rare, as many patients who have never had operative interference in the throat show asymmetry of the pillars of the fauces.

Acute otitis media suppurativa followed tonsillectomy in three cases.

RESUME OF COMPLICATIONS.

Fatalities (probably embolism).....	1
Pulmonary abscess (recovered).....	1
Bronchopneumonia (recovered).....	3
Postoperative ether pneumonia (recovered)....	3
Bleeding, severe, requiring suture	30
Moderate.....	38
Slight.....	32
Cellulitis of neck	1
Paresis of soft palate.....	2
Abscess in soft palate.....	2
Acute otitis media.....	3
Acute laryngitis.....	2

END RESULTS.

It is manifestly impossible to be accurate in detailing end results of tonsil surgery. Many patients are not seen or heard from after leaving following the operation. From those patients who were seen or heard from, a reasonable time following surgery, we submit reports as accurately as possible.

The reports as to end results of the tonsillectomy alone are not very reliable in a great many cases; as other foci of infection were often eradicated for the same indication, at the same time or near the same time. All known physical and therapeutic measures which were deemed of value were used in con-

junction with the operative treatment. For example, some of the goiter cases had medical treatment in addition to X-ray treatment, goiter surgery and the eradication of any other foci of infection found.

Acne was the chief indication for operation in eighteen cases. Improvement was noted in over one-half the cases. Obviously acne is due to such a variety of causes that this is a promising percentage.

Acute rheumatic fever was the chief indication in eighteen cases. Improvement noted in the majority.

In fifty-five cases the chief indication was subacute and chronic arthritis. Good results were noted in about one-half of those cases. No bad results noted.

In fifty-seven cases the chief indication for tonsil removal was a chronic bronchitis. Sixty per cent of those cases showed improvement after one year.

The tonsils were removed in seven cases of bronchiectasis. No bad results noted.

Three cases of chorea had the tonsil removed and all were normal one year following operation. Whether or not the operation contributed we are unable to state.

Cervical adenitis was the chief indication seventy-seven times. Good results and improvement in about 70 per cent. No bad results. When one considers the mechanism and pathology of acute cervical adenitis, our results are very good. When we advise removal of tonsils for a cervical adenitis, we do not neglect other treatment and do not expect too much from the removal of a focus of infection only. It should be remembered that an acute adenitis is simply a local manifestation of the protective lymphatic system of the body, endeavoring to localize an infection.

The tonsils were removed as a therapeutic measure in three cases of acute endocarditis. Results good in all three cases.

In 27 cases of chronic endocarditis and in 14 cases of chronic myocarditis the tonsils were removed as a therapeutic measure, the idea being to clear up possible foci of infection. We are unable to attribute accurately much direct improvement to the measure, but feel that it is good therapy and in the interest of the patient's safety.

In 24 cases the chief indication was frequent head colds, for which no more evident cause could be found. After one year or more about 50 per cent reported some amelioration. Four cases had been entirely free of head colds since the operation.

In 19 cases of recurrent furunculosis of the external ear canal, 17 reported relief. Two showed no improvement.

The chief indication for tonsil removal in 10 cases was acute thyroiditis. All of these cases claimed complete relief. In fairness to this statement, we might add that other hygienic measures, such as rest and the ingestion of iodine, were used.

In 14 cases of toxic goiter and in 62 cases of simple goiter the tonsils were removed as a therapeutic measure. No bad results were seen. We are unable to estimate how much amelioration of the goiter symptoms was due to the tonsil removal.

In 38 cases the chief indication for a tonsil removal was headache of undetermined origin. Thirty-eight per cent of these cases were unimproved, 30 per cent thought their headache was better, while 42 per cent reported almost complete relief.

Our best results, perhaps, were in the treatment of eye diseases, which included the following indications for removal of infected tonsils: Iritis, acute and chronic recurrent, 51 cases; phlyctenular keratitis, 6 cases; acute and recurrent corneal ulcers, 20 cases; retrobulbar neuritis, for which no other cause could be found, 5 cases. Improvement of the eye condition was so marked after the removal of infected tonsils that we feel that procedure was justified in almost every instance. In the few cases where no improvement was noted, it at least ruled out the tonsils, and we had an added impetus for further search and study of the case. We have heard the criticism that these conditions all improve under nonsurgical treatment. Granting that this may be true, we feel convinced that the removal of a focal infection in the tonsils not only hastens a cure of the eye condition, but gives the patient the best insurance possible against a return of his malady. Many of these cases had other foci cleared up at the same sitting.

The tonsils were removed in 27 cases during acute attacks of laryngotracheitis. We feel that the laryngeal symptoms and discomfort were shortened in almost every case.

The tonsils were removed 23 times for the relief of chronic recurrent laryngitis of nontuberculous and nonspecific origin. Twenty per cent had no recurrence after a year, 40 per cent thought they were better and 40 per cent were unimproved.

Infected tonsils were removed in 11 cases of acute purulent otitis media and in 21 cases during the operation for acute purulent mastoiditis. The results were so good we advocate it as a routine measure in the treatment of these conditions.

In 53 cases of chronic purulent otitis media the tonsils were removed as a prophylactic measure. In 117 cases of chronic catarrhal otitis media the tonsils were removed. The results were good. We believe the removal of the tonsils gave more relief than any other relief measure instituted. So many other defects were corrected in this group of cases that we could not give any accurate percentage of results attributable to the tonsil removal alone.

In 13 cases of otosclerosis the tonsils were removed as part of the treatment. We can attribute no special improvement to the operative procedure alone.

In 8 cases of rather obscure acute gastrointestinal symptoms of a recurrent type, the mothers reported complete relief after the removal of infected tonsils and adenoids.

In 26 cases of malnutrition of children with infected tonsils and adenoids, marked improvement was reported in 70 per cent following operation. Dietetic and hygienic and other therapeutic measures also were instituted, so that too much weight cannot be attributed to the tonsil removal.

The tonsils were removed as a therapeutic measure in 182 cases for the relief of myositis and myalgia of various parts of the body, and in 32 cases for neuritis. The results were good and the measure appears to be good therapy. We are unable to attribute any definite percentage of good results or failure of results from tonsillectomy to this group, as the majority of these cases had other therapeutic measures in addition, such as removal of infected teeth, drainage of infected sinuses, removal of appendix, gall bladder and so on.

Infected tonsils were removed in 6 cases of acute nephritis during the attack as a therapeutic measure. No bad results noted.

Infected tonsils were removed in 23 cases, in which the chief complaint was nervousness of undetermined origin. Forty per cent of these reported improvement in their general condition. Of the balance we have no record of end results.

In 250 cases the chief indication was obstruction to nasal and oral respiration. The majority of this group were children under ten years of age. Adenoids were removed as well as tonsils. Relief of symptoms reported in almost all of them.

In 733 cases the chief indication for the operation was relief from recurrent attacks of tonsillitis. Relief of symptoms in this group was almost 100 per cent. Occasionally a patient is seen who complains almost as much from a pharyngitis as from a tonsillitis. We do not attempt to insure patients against acute pharyngitis, but as a rule it is slight in distress and duration as compared to the distress from an acute tonsillitis.

In 79 cases the tonsils were removed in an endeavor to prevent recurrent quinsy. Of this group two cases were seen with abscesses in the peritonsillar region after a complete enucleation of the tonsils. This can be readily explained when one takes into consideration the structure of the peritonsillar tissue. After it has been the seat of recurrent abscesses, sufficient infection may remain to become again active when the resistance of the patient is at a low ebb. We feel that one attack of quinsy is an absolute indication for a tonsillectomy.

The tonsils were removed 27 times during an attack of quinsy. Both tonsils were removed at the same time. No bad results noted. In certain cases we found this to very much shorten the time of disability and saved the patient an additional operation. Four of this number were operated upon under ether and 23 under local anesthesia. We prefer the local anesthetic as an element of safety. We have followed this procedure in selected cases since 1914. Dr. H. A. Barnes published reports on the "Radical Treatment of Peritonsillar Abscess by Tonsillectomy" during the acute stage of the disease, in 1915.

In 41 cases of infection of the tonsillar tissue by Vincent's fusiform bacillus and the spirillum, the tonsils were removed during the acute process. The results were good in that the time of disability was shortened, except in one case, where the infection spread to the soft palate with considerable scar-

ring and deformity. This patient was severely sick, which necessitated a seven weeks' stay in the hospital following operation. This complication cooled our ardor somewhat, and we are not sure that it is good surgery to operate on the tonsils in the face of an active Vincent's infection. In those cases of Vincent's infection where the infected area was strictly confined to the tonsillar tissue no bad results were noted.

The tonsils were removed as a therapeutic measure in 86 cases of recurrent sinus infection. About 75 per cent of this group reported improvement in their condition. From the proximity of the structures and the statistics of Dr. Dean and others in the management of sinus disease in children, it seems to be good therapy. In children especially we usually advise removal of infected tonsils and adenoids before advising any surgical interference with the sinuses.

Twenty-one cases of vertigo were relieved in children by the removal of infected tonsils and adenoids. In adults the percentage of relief from tinnitus and vertigo was much smaller after tonsillectomy. We have no records of adult patients in which we were sure tinnitus and vertigo were due to tonsillar infection alone. So many adults suffering from tinnitus and vertigo are carrying such a multiplicity of foci and defects that we advise a general physical examination and the elimination of all possible removable factors.

CONCLUSIONS.

Tonsillectomy should be regarded as a major surgical procedure. When performed under the best of conditions it is not always devoid of complications.

The tonsils are very often harbingers of infection, which may be deranging the individual's health and causing symptoms in parts of the body far removed from the tonsils.

To safeguard the best interests of the patient, tonsillar infection should be regarded as only a part of their symptomatology until proven otherwise.

In considering a mechanism so complex as the human body, and one exposed to so many ills and ailments, it is manifestly impossible to detail accurately results from therapeutic measures directed toward one part of the body only. Modern

therapy requires that a fair share of attention shall be devoted to the entire organism, and treatment directed toward many points, if the best interests of the patient are conserved.

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LXIX.

TUBERCULOSIS OF THE RESPIRATORY TRACT
VIEWED FROM THE IMMUNITY AND
BIOLOGIC ASPECT.*

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I shall endeavor to justify the presentation of this paper by reciting the history of what appears to me an unusually interesting and instructive case.

History of case: H. R., male, 25 years of age, came to consult me two years ago complaining of vague nervous symptoms and of great difficulty to concentrate his mind on his work, so much so that he had to quit and remain indoors for at least one week at the time, in a state of utter apathy and dejection.

He also complained of dryness in his throat and of dripping of mucus into and from his nasopharynx. These nervous attacks would gradually wear themselves out in about ten days, only to return regularly six months later.

It appeared to me that he was suffering from a mild psychic depression, and, cognizant of the fact that a chronic sinusitis may occasionally be behind it, I went very carefully over his accessory sinuses and found them normal clinically by transillumination and X-ray. The only abnormality present was a deflected septal wall with a high deviation, sufficiently able to block the drainage of the frontal sinuses.

I made clear to him the possible remote relationship between his nasal and mental condition, sent him to a prominent neurologist, but also suggested the correction of his deformed septum as the best means of relieving the annoying throat symptoms.

I saw him on several occasions during the following two years; he reported considerable improvement in his mental condition but still complained about his throat.

*Read before the Medical League of Philadelphia, January 24, 1927.

In June, 1925, he requested me to relieve him of his nasal ailment, and on the 26th of that month I performed a sub-mucous resection under local anesthesia; the operation lasted about 30 minutes and he left the hospital the following day, in fine condition.

The therapeutic effect became noticeable after the first week, and when it seemed that both of us had reason to be satisfied with the accomplished results, he started to be annoyed with his old trouble of mental fatigue and was actually compelled to relinquish his job on that account.

However, after a few weeks of rest, matters adjusted themselves, the shock of the operation was on the wane, but he began to suffer with headaches, ran a temperature of 101 to 103 degrees, his pulse jumped to 120 and his respiration became quickened and strained.

I diagnosed a gripe, because he exposed himself a few days ago, for several hours, to inclement and very raw weather, and ordered him to bed for a full week, with beneficial result.

Shortly, though, he reappeared at my office with his old batch of complaints, augmented by a brand new one, that of a harassing cough. I sent him back to bed with the diagnosis of a relapse, but I became suspicious from my physical examination that all is not well, and I reminded myself, incidentally, that three years ago he lost a younger sister with pulmonary tuberculosis.

I communicated to the family the unpleasant news. They became—rightfully so—greatly alarmed and blamed me in no uncertain terms for the entire affair. During his stay in bed he lost, in the course of one week, his fever, the cough subsided, but he persisted in showing that slight and ominous rise of a few points in his afternoon temperature. I concluded that my fears were justified and had them confirmed by the fluoroscope, X-ray and sputum examination, the latter showing from 2 to 12 bacilli in the field.

I immediately referred him to a chest specialist, with the request to keep him at home, should it prove feasible, in order to meet the strenuous objections of his parents against a sanitarium.

He finished his eight weeks of confinement to bed by November 1, 1925, with a net gain of 21 pounds; his afternoon rise in temperature disappeared after the third week; his cough subsided so completely that no sputum examination was possible; his appetite became ravenous and the exhaustion a thing of the past.

His general appearance improved to such a degree that his physician characterized it by one word, "incredible," and only for safety's sake he advised his staying in bed for another four weeks. A thorough physical examination at the expiration of that period revealed a clinically robust, well nourished and fine looking individual, and fortunately this condition persists to this day.

I might add that his parents are healthy people in every respect, that two brothers and four sisters are living and enjoying excellent health, that I personally know this patient for at least a dozen years, and I feel quite certain that at no time was there the remotest suspicion of any tubercular affection.

When he submitted to the operation he was, according to his own feeling, to my impression of his general condition and to that of the examining house physician, a perfectly healthy person. His physical examination, as recorded on our hospital chart, reveals "no cardiac, no respiratory trouble, a negative urine, and normal temperature, pulse and respiration"; nevertheless, two weeks following a perfectly harmless operation—like a thunderbolt out of a clear sky—we are face to face with a full fledged pulmonary tuberculosis.

Fortunately for all concerned, this episode had a happy ending, but could not the opposite have happened just as well? I confess to many days of worry on this account, but also to have learned something—as we usually do from our reverses.

How is this case to be explained and evaluated?

It is obvious that my patient harbored a clinically nonmanifest tuberculosis, and it would be idle waste of effort to dispute the damaging action of the operation; but why should a subjectively and objectively peaceful infection be stirred to renewed activity by an insignificant shock and then again revert to its previous status of apparent quiescence in such a short space of time?

Superficially, the answer is quite simple. Somehow some such factors as "lowered resistance, disposition, anatomic peculiarities, etc.," have rekindled smoldering ashes, and in the very same mysterious way brought the conflagration to an early standstill.

The trouble, though, with this argumentation is that it sidetracks the issue instead of meeting it and substitutes one problem with another.

Granted that all these factors do exist, we still owe an explanation concerning their mode of action. How, for instance, do "lowered resistance and disposition" work? Is the individual, under certain conditions, disposed to become a favorable medium for his germs, or is the parasite suddenly inclined to change its hitherto, so to speak, friendly attitude?

In what manner and why does "anatomic disposition" change the healing tendency exhibited by this patient throughout his life into a manifest disease on such slight provocation as a septum operation?

When the problem is approached in this way, with the object of correlating cause and effect, then we should admit that we are groping in the dark; and while we talk of "disposition, anatomic habitus and what not," we are aware of the existing confusion as to their scientific concept and their physiologic mechanics.

Because it is hardly sufficient to know the morphology, pathology, the portal of entrance and the dissemination pathways of the tubercle bacilli within the human system—as highly important as these factors are.

We must, more so, understand and plausibly explain the bewildering diversity of the clinical pictures met with. We must answer the question, why the same germ remains a harmless saprophyte in one instance and assumes a most virulent character in another; or why, from all individuals infected with tubercular germs, only an insignificant minority exhibit the "disease."

These pertinent questions are hard to answer, and will probably never be otherwise as long as we overlook the fact that a tubercular focus anywhere in the body, far from being an isolated affair, is but the visible evidence of a systemic infection and in all certainty one of the links in a chain of scattered

foci, even though we should be unable, at the time, to put our finger on them.

The essence of tuberculosis, in the last analysis, is not the pathologicoanatomic change in the tissue structure with its correlated clinical symptoms; not the gross anatomic configuration of the chest, but the manifest biologic reaction of a life-long struggle between the invading germs and the resisting forces of the threatened human organism.

While the bacteriology of the germs and the pathology they create are very essential to the understanding of the nature of tuberculosis, our conception of same and the application of the proper therapeutic agents will always be faulty and unsatisfactory as long as proper understanding of the biologic phenomena involved is lacking.

Thanks to the rise and spread of the science of immunity, many heretofore baffling and mystifying problems became clarified and many puzzles were brought to a satisfactory and rational solution.

From the point of view of immunity, every infectious disease—tuberculosis included—is the aggregate of all biologic and anatomic manifestations resulting from the reciprocal reaction of invading organisms looking for shelter and the opposing cellular forces struggling to ward them off.

Accordingly, the inception of an infectious disease dates back to the moment of invasion, no matter how remote; and when the pathologic changes become noticeable we already witness the end results of a showdown between the two struggling forces, with the temporary or permanent defeat of the defense.

From the very instant the etiologic microorganisms force an entrance into the human system two entirely strange organisms are compelled to live together, and the process of accommodation to each other assumes the aspect of that great natural law—a merciless struggle for the survival of the fittest.

The resisting forces may equal those of attack. Then the latter are checkmated, paralyzed into inactivity, and the disease enters—clinically but not biologically—into a phase of latency; the struggle is still going on, with the decision hanging in the balance, unless the defensive powers of the individual completely annihilate and overcome the intruders and bring

about a clinical as well as a biologic cure. The microorganisms may gain the ascendancy, break down every barrier of resistance and bring about the "clinical" disease with its specific characteristic symptoms.

The momentum of the attack and the strength of the defense are dominating the life of all infectious diseases, with the odds in favor of one or the other at the various stages of their evolution.

The interpretation of tuberculosis from the strict pathologicoanatomic standpoint met with great difficulties in the attempt to classify the manifold variety of apparently inordinate clinical manifestations, and no two investigators could agree on this subject.

In 1897, Petruschky called attention to the fact that in the more or less extended course of the tubercular infection, notwithstanding the confusing irregularity of clinical pictures, certain typical phases do recur with unfailing precision and impress their stamp on the clinical situation predominating at the time. He, therefore, suggested to divide the span of life of the tubercular disease into three stages along similar lines to Lues.

Following the same line of thought Ranke, in recent years, succeeded in giving these three main stages an anatomic foundation. He demonstrated convincingly that the characteristic histologic changes they are associated with are but the true reflection of the reactive powers within the human system. He calls them "histologic allergies," and they are, generally speaking, fluctuating with the fortunes of attack and defense.

The primary stage is characterized by the "primary complex," consisting of the following: (a) The original focus at the portal of invasion—a tubercular nodule with central caseation, with corresponding metastatic dissemination in the regional lymph glands, and (b) an inflammatory zone around the primary focus and a periadenitis of the affected glands.

According to Ranke, the irritation set up by the tubercle bacillus is responsible for a twofold reaction in the body cells:

1. Mechanical *t. w.*, that called forth by the intrusion of the foreign body, causing proliferation of the adjoining tissues and resulting in a tubercular nodule, and,

2. Chemical t. w., that caused by the stimulation of a toxin diffused by the germ.

The latter expresses itself by inflammatory disturbances in the form of edema, hyperemia, leucocytic infiltration, liquefaction, necrosis and caseation of the surrounding area, resulting in a more or less intense perifocal inflammation.

The human organism answers this attack by a mobilization and organization of its forces of defense and resistance, and one of three possibilities may happen.

1. The two opposing forces balance each other; then the disease becomes, clinically speaking, stationary, and the individual is enjoying full health, although the biologic struggle is going on unnoticed.

2. The defense outweighs by far the strength of the attack; then a process of cicatrization is induced resulting in the encapsulation of the focus of infection, without clinical symptoms ever manifesting themselves.

3. The resisting forces lack vigor; then every barrier is broken down and swept away; the invasion spreads itself all over the system and thus is the generalized, secondary phase ushered in.

The effort of the cellular forces to meet the onslaught of the invading hordes of tubercular germs is called by Ranke the "first allergy."

The secondary stage is characterized by dissemination of the tubercular infection over the entire human organism and is due to the breaking of an isolated primary focus (gland) into the blood stream, either directly or through the lymphatic system by way of the thoracic duct.

The disease loses its localized character, becomes generalized, and we observe a multiformity of anatomic pictures ranging from the mildest metastatic foci in the various viscera, bones, joints, eyes, ears, larynx, etc., to the most destructive miliary form.

Biologically, the appearance of the tubercle bacilli in the general circulation stimulates the generation of antibodies, and their presence in the blood is responsible for what is called humoral immunity.

The reaction by which this is accomplished causes the tissues to become hypersensitive to the tubercular toxin, due probably to poisonous by-products (endotoxins) elaborated during the process of digestion of foreign proteins (toxins).

The slower the destruction and the less complete the absorption of these endotoxins, the more marked the hypersensitivity or anaphylaxis of the tissues. The stronger the invasion, the more probable the discrepancy between the amount of toxins to be destroyed and the phagocytic elements available or to be mobilized.

Ranke calls this pathognomonic anaphylactic reaction of the secondary stage, the "second allergy," and proves by histologic specimens the preponderance of the toxic element over that of the foreign body component.

This altered biologic reaction will cause typical changes within the tubercular nodule itself, manifested by an increased caseation and necrosis; and also in the perifocal zone, resulting in a considerable extension of its size, due to a massive infiltration of leucocytes and red blood cells.

The first stage is characterized by its tendency to productive and indurative changes in the tissue structure, while the second, due to hypersusceptibility of the cells to the toxins of the germs, is noted for the predominance of inflammatory disturbances around the original focus (perifocal inflammation) and involvement of adjoining tissues.

The perifocal zone is significant in many ways.

1. We appraise the severity of a tubercular infection by the intensity of the surrounding inflammation and the degree of its interference with the proper functioning of the neighboring organs.

2. It is the direct cause for the great variety of pathologic changes in the affected tissues. These alterations in the histologic structure of the involved areas depend, in the last end, upon the reactive powers of the stimulated cells and upon the massiveness, frequency and duration of the attack.

The number of invading germs may be large or small; they may break through suddenly, within a very short space of time and spread like wildfire; or the dissemination may progress very slowly in a series of successive attacks extending over a considerable period.

The reactive response of the irritated body cells is the second factor in determining the intensity and extension of the perifocal zone, and both combined are the underlying cause of the manifold variety of histologic pictures observed in the various phases of the disease.

3. The perifocal are, furthermore, by undergoing periods of quiescence and acute exacerbations, in direct relationship with the rise and fall of the body immunity, and are, in a sense, the true mirror of the available or missing defensive forces and also of their qualitative value.

If the number of attacking germs is large, if the invasions are succeeding each other at a rapid pace over a short stretch of time, the human body has neither time nor sufficient strength to build up and fortify its defensive powers.

The result thereof is a defective immunity, with every attempt of resistance put forth swept down to defeat, and the individual may fall prey to his infection under the distressing symptoms of miliary tuberculosis.

If the opposite takes place, the result is a powerful immunity, sufficiently strong to bring the progress of the disease to a longer or shorter standstill—to a more or less extended period of latency.

When this stage has been reached the disease enters the third phase.

The generalization, so typical of the previous period, has spent its force and becomes either negligible or comes to a stop altogether; the lymphatic and hematogenous dissemination ceases and the disease becomes once more localized, in the sense that from now on the existing foci are spreading by contiguity and may destroy great portions of the viscera so affected.

This third phase, called by Ranke the "third allergy," is also characterized by a change in the biologic reaction from a hypersusceptibility to a relative loss of sensitiveness on the part of the tissues for the diffused tubercular toxin, and expressed histologically by a receding perifocal area.

The foreign body component comes again to the forefront, and we now see small epithelioid tubercles, without a perifocal zone, with no tendency towards encapsulation, eating their way into and involving entire organs.

The disease assumes a chronic, slowly progressing character, interrupted by fresh exacerbations, which the available relative immunity may or may not withstand.

In sharp contradistinction to the pathologic-anatomic point of view, with the main emphasis on the so-called "constitutional disposition," the biologic theory maintains that all clinical, pathologic and histologic manifestations of this, as of any other infectious disease, are the outcome of biologic reactions within the human system, and are the response given by same to the irritation set up by the attacking germs and their toxins.

The fundamental laws of biologic reaction governing the congenital or acquired defense mechanism—the antibodies of natural or acquired immunity—regulate, shape and determine the progress and evolution of the various stages of tuberculosis and not a haphazard "constitutional disposition or anatomic configuration."

An analytic survey of this case, in the light of biologic conception, offers, I believe, a satisfactory and plausible answer to the questions asked at the beginning of this paper.

As usual, the patient contracted his tubercular infection in early childhood; Pirquet and Hamburger claim that 90 to 100 per cent of all urban children below the age of 12 years are affected with tuberculosis.

The original focus may or may not be present, but we should not fail to find metastatic regional lymph glands. In this instance the X-ray showed an enlargement of the peribronchial glands.

There is no record in his past history of any secondary attacks, but in all probability they must have occurred, in mild outbreaks perhaps, and in all likelihood diagnosed as something else; but granted there were none, then it is by no means unusual to come across such a prolonged period of latency, provided there are enough antibodies in the general circulation to stave off the invasion of tubercular germs or to neutralize their toxins.

His present illness may, therefore, be either an acute exacerbation of a period of quiescence—a mere interruption of the many interspersed healing pauses—or the outbreak of the second stage itself. However, it is immaterial from the practical standpoint to argue for one or the other possibility.

Suffice it to know that a massive or virulent invasion of tubercular germs swept down in its wild rush some weak link of the defense front, and the body immunity of the hour was unable to cope with their elaborated toxins.

I am not aware of any undermining factors like undernourishment, worry, overwork, etc., that could be blamed in this case. On the contrary, I am more than certain that we had a clinically healthy individual before us, with a well balanced biologic equilibrium between the forces of attack and defense.

Of course, it should not be forgotten that immunity is not eternal, but rather unstable; it is relative and never absolute, in continuous transition and forever fluctuating with the ebb and tide of the disease.

It seems quite possible that his repeated complaints of mental fatigue were but the forerunners and the red danger signals of a crumbling immunity, and when the otherwise insignificant shock of the operation came on, his power of resistance, expressed in terms of antibodies, were so fagged out and on edge, that anything at all was capable to throw out of gear the biologic status quo.

The scales were thus tipped in favor of the invader with the inevitable result of a hematogenous dissemination, manifested clinically by fever, cough, expectoration of bacilli laden sputum, loss of weight, etc.

But here again, fortunately for the patient, the diffused toxins found susceptible tissues which reacted promptly with the elaboration of antibodies in sufficient quantity to saturate and neutralize their damaging poisons.

Supported by therapeutic factors, he acquired an overwhelming immunity, capable of checking the invasion and bring about a period of clinical quiescence and latency in the short period of not quite three months.

Is he clinically cured? To all appearances and for the time being—yes.

Is he biologically cured? This depends on whether his immunity forces were only capable of paralyzing the germs into inactivity or powerful enough to annihilate them and rid the system of their presence.

Does he run danger of a renewed outbreak at the next, necessary, operation? While this question is hard to answer in

the affirmative, it is the better part of wisdom to exercise extreme caution.

In what way? By a routine testing of existing immunity on similar lines to the X-raying of the thymus, or the coagulation of the blood.

I would suggest that the history of every operative nose and throat case, should carry information about Tb. possibilities (glands, rise of temperature in the afternoon, night sweat, cough, fatigue, etc.), to be confirmed in suggestive cases by a fluoroscopic transillumination.

Each and every case should have a skin test performed and repeated several times, when necessary.

A repeatedly positive Pirquet or other very fine skin test (Much) correctly done and interpreted, points to the existence of tubercular infection, with the resulting storing up of specific antibodies, and a well balanced equilibrium between natural antigens and cellular defense.

A tubercular focus in the sense of visible clinical manifestations, in other words what we call in practice "disease," may nevertheless be hard or impossible to demonstrate.

Successive negative results indicate a high cellular defensive power, capable of neutralizing rapidly and thoroughly any amount of toxins and thus keep the system free of the disease.

Tuberculosis may be excluded in the vast majority of cases whenever an otherwise healthy individual shows a negative skin test in a repeated number of trials.

Within the framework of the clinical picture and in conjunction with the history and physical findings in a given case, the spontaneous and experimental immunity reactions are of the highest importance in arriving at an early diagnosis and also of great value concerning the prognosis and the line of therapeutics to be followed.

This is our only protection against unavoidable pitfalls and the safest way to circumvent disaster for both patient and surgeon.

It must be said right here that an occasional handling of a tuberculin syringe is no criterion for correct technic or accurate interpretation, and it better be left in the safe hands of an immunologic clinic.

CONCLUSIONS.

1. Our goal of achievement should be the diagnosis of tuberculosis before visible pathologic changes are noticeable; because when their presence becomes manifest, the tubercular disease is difficult or impossible to cure.

2. Tuberculosis starts with the incubation of the tubercle bacilli and from the very moment they begin to thrive on human tissues. The "disease" is present, bent on destruction, even in the so-called period of "inactivity," except it is kept in check by a well developed resistance.

3. Whenever a break occurs in any part of the defense line, the disease is on the upward trend and manifests itself by the immunity reaction of anaphylaxis—in the form of general systemic symptoms, mostly fever, or by the progressive extension of preexistent foci.

4. Testing of immunity reactions is of highest importance in the diagnosis, prognosis and therapeutics of tuberculosis; it assists in detecting the "disease" when it is, clinically so to speak, nonexistent; it presages its future fate, what the mere pathologic picture cannot do; and it points the way to an intelligent and rational course of specific treatment.

5. If nothing else, it arouses our suspicion that we may deal with a potential tubercular individual and commands great caution, for fear of dislocating a well balanced immunity equilibrium.

1024 SPRUCE ST.

STREPTOCOCCIC LARYNGITIS: REPORT OF A
CASE WITH A VERY RARE
COMPLICATION.*

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Streptococcic laryngitis with sufficient pathology to produce definite dyspnea and stridor does not occur frequently. Occasionally it is seen, however, and the laryngologist should always be on his guard against the same when the infection is not definitely diphtheritic as shown by the clinical or laboratory findings.

A case is first presented, because (1) it shows the difficulties of a differential diagnosis; (2) this particular case was complicated by what was apparently an aplastic anemia, which is rare in an adult, but even more rare in a child. The history is briefly abstracted as follows:

C. C.—Difficulty in breathing.

H. P. I.—Ten days previously waked up during the night crying. Mother states her breathing was "croupy." Breathing much worse at times; not free and easy any time during illness. Very little coughing. Would have to prop her up in bed at times so she could breathe.

P. M. H.—Full term baby. Normal labor. Has had chickenpox and mumps. No other diseases except influenza four years ago. Mother states had not been robust for last two years. Color has not been good during this time. No history tarry stools, hemoptysis or hematemesis. No symptoms referable to cardiovascular, genitourinary or nervous systems. Toxin anti-toxin given a year ago.

F. H.—Four other children living and well. No miscarriages. No history tuberculosis or blood dyscrasias.

Physical Examination.—General. Female child, eight years of age, well nourished. There is a definite pallor of the skin

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with a very slight yellowish tint. Marked stridor is present with occasional harsh, "brassy" cough. She is evidently very much exhausted. The breathing is that of obstruction and not air hunger.

Head.—Eyes show no abnormalities. The nose and ears are negative. The tonsils are moderately enlarged, and there is pallor of the mucous membrane throughout the mouth and throat. No follicles on tonsils and no membrane or exudate on pharynx. By indirect laryngoscopy, the larynx is seen to be much swollen, reddened and apparently contains some exudate. Cords not seen. There is no enlargement of cervical glands.

Chest.—There is slight play of accessory muscles of respiration. The apex of the heart is at the mammary line, and there is a rather loud, blowing systolic murmur over the apex (probably due to anemia). Other than the above there are no findings of importance. The axillary glands are not enlarged.

Abdomen.—There are no findings of importance. Particular attention was paid to spleen and liver, which were not palpable. The inguinal glands are not enlarged.

Extremities.—No ataxia, paralyses or neurologic findings of importance.

Laboratory.—Using very careful technic, smears and culture were at once made from larynx. The former showed no diphtheria organisms. Often these can be found in a smear.² Blood count: W. B. C., 8,200; R. B. C., 1,870,000; Hgb., 33 per cent.

Tentative Diagnosis.—Acute streptococcic laryngitis with severe anemia of undetermined type.

Therapeutics and Course.—It was very evident that she could not be permitted to waste her vitality struggling for air. She was at once intubated with a No. 6 O'Dwyer tube. No relief was obtained, and a tracheotomy was then done, under local anesthesia, using a No. 3 Jackson tube. Following this there was immediate relief from her respiratory difficulties. She was put on the routine treatment discussed in a previous paper.² In addition to such tracheotomic care, she was digitized and given fluids by hypodermoclysis.

Despite all treatment she lost ground, though her respiratory relief was permanent. There was intermittent vomiting of

"coffee grounds" vomitus. She ran a moderate intermittent temperature (100 axillary). Five days after admission to the hospital she was given 300 cc. of citrated blood. Following this she temporarily rallied. She died exactly one week from date of admission.

SUBSEQUENT LABORATORY FINDINGS.

Date	W. B. C.	R. B. C.	Blood Counts	
			Hb.	Differential
Jan. 18	7,000	1,316,000	20%	Not reported
Jan. 19	15,800	1,600,000	25%	{ Polys. 87%
				{ Lymphs. 12%
				{ Trans. 1%
Jan. 21	11,300	1,370,000	25%	{ Polys. 85%
				{ Lymphs. 15%
Jan. 23	(Two days after transfusion)			{ Polys. 92%
	10,900	1,690,000	35%	{ Lymphs. 8%

There were never any abnormalities of the stained blood film found. Malaria parasites were not found.

Culture of Larynx.—Practically pure nonhemolytic streptococcus. Wassermann negative; urine essentially negative. A parasite was found and reported as probably trichomonas vaginalis, which was, therefore, of no pathologic significance. Stool: three successive examinations showed no ova or parasites, but all were strongly positive for occult blood.

Postmortem Findings.—The family refused permission for an autopsy. The undertakers, however, found it necessary to open the abdomen. The writer was present and made a complete examination of the stomach and intestines. There was absolutely no apparent pathology of the stomach and small intestines (particular attention was paid to the duodenal cap). The large intestine presented no abnormalities. The other abdominal organs were normal to inspection and palpation. There was no enlargement of the retroperitoneal glands. A few small petechial hemorrhages were present in the mesentery and a few areas of ecchymosis in the intestinal walls.

Revised Diagnosis.—(1) Aplastic anemia; (2) a superimposed acute streptococcic laryngitis.

Discussion.—The literature on streptococcic laryngitis is not extensive. These patients will present almost identically the same symptoms as a primary laryngeal diphtheria. Smears

and cultures from the larynx only will definitely decide the question.

The statement has been made that intubation is contraindicated in nondiphtheritic laryngitis.⁵ This question is debatable. It is true that tracheotomy is usually necessary because of tracheal swelling. Streptococci tend to involve the whole respiratory tract. Diphtheria tends to be more localized in the throat and larynx, though it, too, may attack the trachea. Should not a test intubation be done first? If not at once successful, proceed to tracheotomy as one does in laryngeal diphtheria. Certainly it seems too radical a statement to say that stenosis will always follow a successful intubation just because the infection is nondiphtheritic.

Recently the writer has seen one other case of what was probably laryngitis of this type. The patient, a baby, aged nine months, had been seen one morning with what was apparently an acute nondiphtheritic infection of the nose and throat. That evening a hurry call was received from the same home. On arrival the baby was found in collapse, gasping for breath. A No. 1 intubation tube was hurriedly put in place. A few minutes' temporary relief was obtained, but the baby stopped breathing with the tube in situ. It was necessary to do an emergency tracheotomy in the home. The baby was resuscitated by artificial respiration. With hospital care, a complete recovery was made with no complications. Culture of the tracheal secretions did not show any diphtheria organisms.

One might ask, "Why such a detailed report?" Because it lays emphasis on the importance of a broad perceptive of the patient by the specialist. Those engaged in specialty work should eternally be connecting local pathology with general systemic conditions. Only by such intensive study is worth while clinical data secured. Moreover, greater respect will be forthcoming to those engaged in specialty work.

SUMMARY.

It is believed, then, that the laryngitis was wholly incidental to and superimposed on an aplastic anemia. The blood picture was either this or that of severe and repeated hemorrhage. In the absence of pathology in the gastrointestinal tract, the occult blood of the feces was probably due to capillary oozing.

in turn, due to changes in the constituency of the blood. Therefore, there being no demonstrable hemorrhages of any extent, the only diagnosis remaining is aplastic anemia. It is true that there never was a leucopenia, but on the other hand there never was a leucocytosis until after tracheotomy, and then very slight and transitory. The leucemias, von Jaksch's disease, purpura hemorrhagica and pernicious anemia can all be eliminated by clinical and laboratory findings.

Edema often occurs in a severe anemia. Consequently, such might happen in the larynx and explain the respiratory obstruction. Nevertheless, the vascular disturbance usually first manifests itself in the ankles.³ There was no swelling anywhere on the body of this child. It seems unreasonable to assume that such should occur first and only in the larynx.

One should never hesitate to do a tracheotomy in such a case. The patient is at once made comfortable and the vitality conserved. This, of course, providing that the dyspnea is due to real obstruction and not an air hunger per se. A clear cut distinction must be made between these conditions. The latter is apt to occur in any impoverished condition of the blood.

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LXXI.

OPHTHALMIC CONTACTS WITH OTOLARYNGOLOGY.*

By W. H. LUEDDE, M. D.,

ST. LOUIS.

Your official slogan for this meeting ("O wad some power the giftie gie us to see oursel's as ithers see us") permits, and in fact compels, participation by nonmembers. I appreciate deeply the opportunity that has been granted me to enter into your discussions. Anatomically, physiologically and pathologically, rhinology and ophthalmology have been intimately related from the beginning, but it was reserved for scientists and clinicians within our own lifetime to discover the extent of the relationship. Your ophthalmic colleagues frankly acknowledge and admire the exquisite skill displayed and the painstaking study of details contributed by otolaryngologists toward this end. Genius has been defined as "an endless capacity for detail." An up-to-date, competent otolaryngologist certainly is a genius. An endless variety of details from every department of medical science demand your attention for the welfare of your patients. In ophthalmic practice we find your efficient cooperation an indispensable boon.

We are dealing with organs of special sense, but the rhinologist must approach his problem in a somewhat different attitude from the ophthalmologist. Rhinologists quite generally and properly consider the primary function of the nose to be its relation to the act of breathing rather than to the olfactory nerve. The predominant importance of the nose as an organ of breathing rather than of smell, so far as the human family is concerned, has been emphasized by the speculations of well known English anthropologists. They pointed out that the demand for greater capacity to warm and moisten inspired air in the cold northern climates has given the Esquimaux a long,

*Read before the Middle Section of the American Laryngological, Rhinological and Otological Society, St. Louis, Mo., Jan. 31, 1927.

well developed nose, while the contrary is evident in the nose of the African negro. Except in relatively rare cases, such as malignant tumors of ocular or orbital origin, the preservation of the special sense of vision at its best is the chief aim and purpose of all ophthalmic treatment. This difference in objectives may be a potential disturbing factor in our ophthalmic contacts with otolaryngologists, but it should not be a cause for serious differences. So important is vision to everyone that we rely implicitly on your assistance in preserving eyesight at any cost, when it can be done without putting life itself in jeopardy.

Otology must yield to rhinology in the frequency of ophthalmic contacts. Many ocular phenomena that have been reported during the presence of ear diseases are probably merely coincident and without etiologic significance.

E. Berger (*Encycl. Franc. T. iv, p. 97*) records epiphora photophobia, conjunctival hyperemia and blepharospasm as the result of reflex irritation conveyed from the ear to the eye by way of the trigeminus. Nystagmus and conjugate deviations of the eyes noted in affections of the labyrinth and semi-circular canals indicate the close association between the coordination centers of the ocular movements and equilibrium. Toxins may explain the occurrence of paralysis of accommodation or paresis of extraocular muscles, or even of optic neuritis, that have occurred in the course of infections of the middle ear, but it is difficult to exclude the clinical probability that these ocular symptoms were more directly connected with a coexistent infection of the nose and throat. Infection transmitted from the ear by way of the tympanic and pterygoid venous plexuses to the ophthalmic vein was held by Weithe to be responsible for an orbital abscess.

In more than one-half of some 200 cases of intracranial complications following otologic infection, Gradenigo reported changes in the ocular fundus (papillitis). This ocular symptom was more frequent in cerebellar abscess than in cerebral abscess. In the development of an extradural perisinusoidal abscess, changes in the appearance of the optic disc may be the only sign of this complication and thus furnish an indication for surgical intervention by the aural surgeon. Although

not very frequent, this opportunity for cooperative case study by oculist and aurist is too important to be overlooked.

Diseases of the nose and throat may give rise to a great variety of ocular manifestations. They range all the way from slight functional derangements to complete and permanent loss of sight and even panophthalmitis. The latter catastrophe may be caused by severe infection conveyed to the eyeball through the orbit by direct continuity from the nasal sinuses or by metastasis. Fortunately, such an uncontrollable spread of infection is quite exceptional.

It is easy to understand how the extension of a nasal sinus suppuration may cause orbital cellulitis and abscess formation. Obviously, in such cases, the welfare of the patient demands efficient drainage through the nose. In my entire experience I can recall only one such case in which there was any lack of spontaneity in the cooperation required from the rhinologist. Even he recovered from his astounding indifference in time to achieve a fairly satisfactory result.

Nor is it difficult, in my experience, to get the most cordial cooperation of rhinologists in correcting anatomic variations or nasal inflammations which may be etiologic factors in diseases of the lacrimal sac and obstruction of the nasal duct. You are to be complimented on the skill you have demonstrated in establishing nasal drainage in this class of cases by special operative procedures. In my opinion, such an attempt to secure drainage should always precede final decision to extirpate the lacrimal sac, though that may not be the undivided sentiment of ophthalmologists. In my experience, simple drainage and persistent cleanliness will permit the cure of chronic suppurative dacryocystitis even after there has been repeated abscess formation with ill advised external drainage and the formation of cutaneous fistulæ. I have never yet found it necessary or desirable to excise the lacrimal sac. But these results were not achieved without the very able and much appreciated assistance of my rhinologic confreres.

The possible etiologic relations between acute or chronic coryza and conjunctival inflammations, especially when due to the pneumococcus, is too apparent to require further elucidation. Proper nasal treatment often eliminates the primary seat of the infection and avoids recurrent attacks.

Anatomic research having demonstrated variations in caliber of the bony optic canal as well as defects in its walls, it need not astonish us that simple pressure upon the optic nerve within the canal may produce serious loss of vision without causing demonstrable changes in the appearance of the optic disc or the ocular fundus. As the ophthalmic vein returns from the orbit through the superior orbital fissure, constriction of the optic canal will not cause passive congestion. Vision may be greatly impaired by pressure on the nerve long before it is sufficient to cause a perceptible diminution in blood supply furnished by the ophthalmic artery, which accompanies the nerve in its passage through the optic canal. Simple pressure on the optic nerve produces impaired function without inflammatory changes, just as compression of a peripheral nerve permits the foot to go to sleep.

True optic neuritis may be due to toxins or focal infection or constitutional disease. Direct infection of the tissues of the optic nerve by bacterial invasion from the postethmoid or sphenoid sinuses has been demonstrated on postmortem examination. Optic neuritis is quite likely to be followed by atrophic changes, the degree being dependent upon the severity and extent of the toxic invasion. Even in the presence of a constitutional disease like syphilis, the possible etiologic effect of nasopharyngeal disease in a case of optic atrophy must not be overlooked. A discriminating etiologic study of optic neuritis is by no means a simple problem. The distinction between simple papilledema due to intracranial pressure and the swelling due to a neuritic inflammation caused by bacteria or toxins is not always as easily made in actual practice as it is theoretically. Recently, I reported a case in which a distinguished surgeon had trephined both temporal bones to secure cranial decompression for the relief of a bilateral optic neuritis accompanied by nausea and headaches. A well known neurologist had failed to find a localizing symptom. Six months later, after sight had been lost from postneuritic atrophy, relief from the persistent headaches which had continued unabated was obtained by drainage of a bilateral sphenoid abscess. In this case no nasal examination had been made previously nor even considered. That happened fifteen years ago. The patient is still alive and well, although blind. Such an occurrence is almost

impossible today. So well have you demonstrated to the general medical profession the important rôle of nasal sinusitis that no case of headache continuing for months is likely to escape a nasal examination. But are you possibly becoming too sanguine? Several months were lost in two cases of brain tumor seen quite recently, because primary attention was given to the presence of nasal sinus infection. Death established the diagnosis. Ophthalmic and neurologic consultation was not invited until it was too late to intervene successfully. These cases are always serious and challenge the medical profession to give the best that it has in earnest, conscientious team work, including all its well recognized specialties.

Another group of ocular symptoms due to direct contact with the inflamed tissues involved in sinus disease includes neuralgic pains in and about the eyes. Fuchs points out that the close anatomic relation of the ophthalmic branch of the fifth nerve with the sphenoid sinus may give rise to such manifestations when the sinus is inflamed. Similarly, anatomic relations may be blamed for paresis or paralysis of extra-ocular muscles coincident with acute sinus infections. It is obvious that frontal sinus inflammation may cause a special discomfort in near vision on account of traction by the superior oblique muscle, which passes through a pulley attached to the orbital wall.

There still remains for our consideration a large and important group of ocular manifestations that, to borrow a phrase from the radio announcer, may be said to be "broadcast by remote control" from the nasopharynx. The precise manner in which the ocular symptoms in this class of cases are produced will continue to be the subject of discussions. To explain them, various writers refer to reflex nerve impulses, to trophic control through ramifications of sympathetic nerves, to disturbances of collateral circulation, to vasomotor phenomena, and to toxins. In a given case the effect of any one of these causes may be only conjectural, but together they are all factors in the problem that lies before us—ophthalmic contacts with otolaryngology. Your program committee did not anticipate a detailed discussion of each of these influences in the time allotted to this paper. Nor did it contemplate a recital of the various diseases of the eyeball incident to or

merely coincident with nasopharyngeal disease. Clinical experience furnishes abundant evidence that no ocular tissue or function enjoys absolute immunity from the effects of this remote "broadcasting," nor does the extent and severity of the nose and throat disease presage the degree of ocular complications. In fact, at times, the condition in the nasopharynx may seem quite insignificant and yet be associated with definite ocular disease and serious loss of vision. Often the only proof of the etiologic relation is furnished by the cure of the ocular lesion when proper nasal treatment is administered. White's suggestion of the effect of negative pressure deserves further study in relation to these cases. The following clinical history of a case of retinal detachment, in which the attack apparently threatening the second eye was averted by tonsillectomy, suggests tremendous possibilities in the prevention of this dreaded, hopeless ocular disease through your cooperation.

Mrs. V. K., age 45. January 6, 1920. Detachment of retina, right eye, for one year. Now has symptoms in the other eye similar to those which preceded the disaster in the right eye—seeing of "spots" and "flashes." Ophthalmoscopic examinations confirmed diagnosis of extensive retinal detachment in right eye, also revealed moderate amount of fine vitreous opacities, but failed to show anything abnormal in the left eye. Her teeth were being removed to improve dental efficiency by substitution of an artificial denture. X-ray examination showed no focal dental infection, and there was no relief from her subjective symptoms by this radical dental treatment. A small error of refraction in the good eye was corrected. Wassermann test was negative. Nevertheless, the patient was given K. I. without benefit for two months. As the ocular symptoms remained the same, although the nasopharynx was reported practically normal, K. I. was resumed for a while. Then symptoms were interpreted to be purely neurotic and perhaps incidental to the menopause.

August, 1921 (19 months after first examination). Ophthalmoscopic examination revealed some exudate now appearing in vitreous of the good eye. Nasopharyngeal examination and general examination by internist advised.

January, 1922 (two years after first examination). Acute iritis with severe pain in the right eye (the one with retinal

detachment). Numerous posterior synechia, which were completely broken up by atropin by the third day. Dental examination again proved negative, but nasopharyngeal examination resulted in the suggestion of tonsillectomy. The rhinologist finally regarded the tonsils as suspicious, though not notably bad. Treatment of the iritis of the right eye was continued for several weeks with apparent recovery, but the slight cloudiness in the vitreous of the good eye persisted as did the subjective symptoms, the dread of which demanded attention. Also there were now two small points of choroiditis in the good eye in the inferior temporal quadrant near the equator. Immediate tonsillectomy was now urged. March, 1922. Tonsillectomy several weeks ago. Right tonsil contained an unsuspected large calcareous nodule and several other foci of infection. The vitreous was now much clearer.

July, 1926. R. E. Diverges, old retinal detachment, no vision. L. E., V. = 20/15 with correction for small amount of compound hyperopic astigmatism. Uses eyes without discomfort and is free from "spots" and "flashes." Had spell of *muscae volantes* over a year ago, but it was stopped by correcting the position of axis of cylinder in her glass. Ophthalmoscopic examination revealed a clear vitreous.

The insidious onset in this case illustrates the difficulties sometimes encountered. No pathologist could say that retinal detachment in the right eye was the direct result of the infected right tonsil, nor would any clinician expect a cure of retinal detachment from tonsillectomy, yet the train of events justifies the following conclusions:

(a) That the toxins incident to the chronic infection of the right tonsil (which was shown to be of long standing by the large calcareous nodule) probably produced a low grade choroiditis and hyalitis in the right eye. (b) Later, the shrinking vitreous of the right eye, after a prolonged inflammation, brought about a retinal detachment. (c) The toxic effect previously noted in the right eye began to show up subjectively in the left eye before any change could be detected by the ophthalmoscope. (d) An attack of iritis in the doomed right eye brought the patient under observation, and a beginning hyalitis and choroiditis was discovered in the good eye. (e)

Tonsillectomy was followed—not by cure of the old retinal detachment—but by the prevention of the same calamity which threatened the left eye.

Practically it does not matter whether it was bacteria or toxins that caused the ocular lesions, or whether they reached the ocular tissues via blood vessels or lymphatics, but it is important in a doubtful case to eliminate nasopharyngeal infections.

Similar indications have been pointed out in certain cases of glaucoma. In a case of sympathetic ophthalmia that stubbornly resisted intensive treatment, the turning point leading toward recovery was coincident with the enucleation of infected tonsils. In a case of cataract the eye most profoundly involved was found to be on the same side with polypoid degeneration in the ethmoid sinus. Can such a patient be told without reservation that he has a senile cataract, even if he is beyond the scriptural three score years and ten? In view of the comprehensive influence of nasopharyngeal disease upon the eye it certainly behooves ophthalmologists to get your advice before deciding upon the most favorable time for intra-ocular operations to facilitate uncomplicated recoveries.

Although these ocular complications of nasopharyngeal conditions are recognized much more frequently than formerly suspected, they are still to be regarded as exceptional. No conscientious rhinologist would threaten every patient having nasal sinus disease with possible blindness, and yet with our present knowledge he cannot guarantee freedom from such dangerous consequences. It is this lack of certainty which should spur us on to further research concerning our relations as ophthalmologists and otolaryngologists. The fact that certain individuals rarely escape ocular manifestations in recurrent attacks of nasopharyngeal disease while others never have such complications must lead us to suspect anatomic defects or variations. Postmortem examinations confirm this possibility. The frequent bilateral character of these lesions, even after a considerable interval of time, suggests anatomic liability. Circulatory anastomoses, both arterial and venous, between ocular and nasal vessels suggest the avenues by which bacterial infection or toxins may be conveyed. Let us not

forget that the lymphatic channels between the nasopharynx and orbit are not well understood, but that there is no protecting chain of lymph glands between the two. Histologists are not agreed as to the patency of extra- and intraocular lymphatic communications. It may be that protection is afforded when these channels are closed.

We may say that the development of ocular disease related to the nasopharynx is due to that rather vague, uncertain state designated as "lowered resistance," or shall it be called "increased susceptibility" to certain types of infection? These are clearly statements of fact, but they are likewise a confession of ignorance. The distinction between increase in the virulence of the infection or diminished resistance in a given case is frequently impossible. It may mean both. It has long been my conviction that nasopharyngeal disease has a very definite effect upon both the incidence and progress of ocular tuberculosis. It is a familiar clinical experience that acute colds, influenza or bronchitis may initiate or greatly aggravate an attack of pulmonary tuberculosis. In a somewhat similar manner diseases of the nose and throat seem to be a more important factor in ocular tuberculosis than are lesions within the chest. It is a significant fact that about one-half of the cases giving a focal ocular reaction to subcutaneous test injections of tuberculin fail to reveal pulmonary or general tuberculosis. More convincing was the invariable presence of focal disease in the nasopharynx and the benefits noted in the ocular conditions of these cases when under the care of competent rhinologists.

The remoteness of the causative lesion from the local ocular effect makes diagnosis difficult. The failures as well as the successes of our routine daily practice teach us that unless we study our cases from every angle we are unfair to them and to ourselves.

You have achieved such marvelous diagnostic skill with the aid of various special methods, including X-ray examinations, etc., that no one can afford to base conclusions on mere impressions. We must investigate all of our cases with the assistance of every means at our command. Laboratory tests must be applied and interpreted with enlightened clinical experience and anatomic knowledge as a guide. The best specialist is the

broad minded physician who is keen to listen to others and yet is endowed with inherent force to act with celerity upon conviction that action is demanded. We are not overspecialized, as it is sometimes carelessly said. Specialization is needed to secure accurate knowledge of details, but the welfare of the human family submitted to our care demands that we consider our own work in its relation to that of our confreres. Hence, the conception of such a program as this is an evidence of progress in which other specialties may happily follow your example.

However, your slogan implies censure rather than praise, for the immortal bard adds "It would from a' error free us, and foolish notion." The only criticism I could offer applies with equal force to us in ophthalmology as to you in otolaryngology. Our besetting sins seem to be superficiality and skepticism—sins of omission rather than of commission.

Let me illustrate by clinical examples. A young school teacher (E. A., age 28) consulted me a dozen years ago (May 22, 1915) on account of sudden loss of sight in the left eye. She had a pronounced swelling and edema of the optic nerve of this eye, obliterating the normal disc outlines. The retinal veins were engorged and tortuous. There were several retinal hemorrhages near the macula and vision was reduced to 20/100. In the other eye there was some hyperemia of the optic nerve. An adenoidectomy having been done three months before, etiologically suspicion was directed toward nasopharyngeal disease. An examination was requested of her rhinologist, and the serious nature of her ocular lesion was explained to him with the aid of the large Gullstrand demonstration ophthalmoscope. Within five minutes he announced emphatically that there was not and could be no disease whatever of the nose or nasal sinuses. Events that followed soon threw his snapshot decision into the discard. His superficial examination and hasty conclusions gave neither himself nor the patient a fair chance. Possible intracranial conditions as etiologic factors in the optic neuritis were eliminated by a neurologic examination by Dr. W. W. Graves. A rhinologic consultation on the following day revealed a double sphenoid empyema. Medical and surgical drainage of the sphenoids was followed by prompt recovery of normal vision. Rhinologists have no

monopoly on "snapshot" diagnoses. If ophthalmologists were here on trial, equally impressive incidents could be recited of our lack of thoroughness.

Open minded skepticism was at one time Missouri's pet slogan, "Show me." The "Doubting Thomas" of this next incident was a Pennsylvanian, and his name was not Thomas. A patient who had a monocular central retinochoroidal infiltration, which was just beginning and impaired vision very slightly, was found to have a sphenoid inflammation with purulent secretion on the same side and a deflected septum which obstructed drainage. The rhinologist whom she first consulted advised primarily the correction of the septal deformity, and, if drainage were then insufficient, the sphenoid and post-ethmoid cells were to be opened. Another rhinologist, to whom she went for corroboration of this opinion, suggested that direct drainage of the sinuses without operation on the septum would be sufficient, and as this appeared the easiest way she accepted the latter's advice. Medical and surgical drainage of the sphenoid sinus without correction of the deflection of the septum brought striking but only temporary improvement to normal vision. There were repeated relapses, which seemed to be due to obstruction of drainage occasioned by attacks of acute coryza added to the deflected septum. A searching general examination failed to reveal any other cause for the retinitis. The discouraging recurrence of these attacks provoked a desire for a consultation during a visit of the patient the following summer in Philadelphia. I gave her a letter to Dr. de Schweinitz, but he happened to be in Europe at the time and she was persuaded to see one of his colleagues. The latter's statement to the patient was reported by her to me as follows: "Now, Mrs. X., there are two groups of ophthalmologists—those who believe that nasal conditions may be a cause for such retinal disease and those who don't believe it. I belong to the latter group. Forget about your nose and look after your general health and that is all." The patient left Philadelphia for Atlantic City. There she contracted a fresh coryza and her vision was permanently reduced to 20/200, and a large retinochoroidal scar covered the macular area.

Five years ago Dr. Hardesty and I reported to the Section on Ophthalmology, A. M. A., a group of cases of central

retinitis with recovery of normal vision after prompt and effective nasal treatment. These cases were not unique in our experience or in that of other ophthalmologists, but were selected because they convincingly showed the relation of nasal conditions to this type of ocular disease. Ophthalmic contacts with otolaryngology cannot be established or broadened unless we have faith in that possibility. Honest skepticism is a fair challenge to any proposition, and can be answered by education and experience, but conceited ignorance is both intolerant and intolerable.

With the cultivation of mutual confidence and habitual thoroughness, our future cooperation shall bring forth new and interesting facts, and, may we hope, benefits for the afflicted.

LXXII.

FOCAL INFECTIONS OF THE HEAD.

By E. E. Poos, M. D.

DETROIT.

One of the greatest advances made in the practice of medicine is the discovery of the important role that focal infections play in the cause of systemic and chronic diseases.

A focus of infection is a circumscribed area of tissue infected with pathogenic bacteria. It may be primary or secondary. Primary foci are usually located in tissues communicating with a cutaneous or mucous surface, while secondary are due to infections of contiguous tissues or at a distance through the blood or lymph channels.

Focal infections of the mouth and upper air passages are very prevalent and are the basis of many systemic infections. As the mouth is the portal of entry of all food and the nose and throat of all air, it can readily be seen that any infectious foods or air are readily absorbed by the mucous membranes and tissues of the nose, throat and mouth. The most prevalent organisms of the mouth are the endameba buccalis, bacillus coli and various saprophytes. In the saliva and pharyngeal mucus are found streptococci, staphylococci, pneumococci, micrococcus catarrhalis, diphtheria, pseudodiphtheria, influenza and tubercle bacillus, besides other pathogenic organisms.

These infections are not only a menace to the person who has them, but he infects others by sneezing, coughing, expectorating, etc.

These bacteria may be of a latent type but may become virulent at any time, due to exposure to cold, physical or mental exhaustion, debility, alcoholic dissipation or exposure to any of the infectious diseases.

EAR.

ANATOMY AND EMBRYOLOGY.

Kopetzky says: "The susceptibility of the young to infectious diseases such as measles, diphtheria, scarlet fever, and the usual complications of these diseases by middle ear infection are partly explained if one bears in mind the analogy between the embryonal development of the tympanum and the upper respiratory tract. In these diseases the bacteria, exhibiting their inherent selective action in determining the type of tissue they are prone to attack, find similar tissues in the lungs and middle ear, hence the coincidence of the complication.

In the infant we have an additional factor due to the immaturity of the auditory apparatus. The embryonal tissue in the middle ear and mastoid process, which are still undergoing developmental changes, is readily subjected to bacterial invasion and undergoes rapid disintegration. These factors are reinforced by the greater vulnerability of the infant's nervous system, denoted by a tendency to convulsions and relatively slight resistance to the effects of general intoxications produced by the entrance of toxins into the general circulation. In the infant, another factor to be found is the anatomic structure of the eustachian tube. It is short and almost straight and its lumen is open."

Veins of the ear follow the course of the arteries. Those on the posterior aspect of the canal and auricle pass into the external jugular and mastoid veins, while the anterior branches go to join the temporal and facial veins. Lymphatics anastomose with the superficial lymph glands, and with those forming the submucous lymphatic system of the pharynx. The superficial lymphatics over the mastoid, the lymph nodules in front of the auricle and those situated in the cervical region between the platysma and sternomastoid muscles are intimately associated with the lymphatic channels of the meatus and tympanyum, while free lymphatic anastomosis exists in the opposite direction through the medium of the glands situated in the lateral pharyngeal walls.

BACTERIOLOGY.

The most common organisms found in ear infections are various forms of streptococci, staphylococci, pneumococci, diphtheria and influenza.

The most common foci of infection in the ears are chronic otitis media and chronic mastoiditis, which are the results of acute infections, many cases clearing up after removal of the focus of infections in either sinuses or throat.

One of the most recent papers on the mastoid in infants being the cause of severe gastrointestinal disturbances was that of Marriott, Alden and Lyman.

These infants had nutritional disturbances characterized by severe watery diarrhea, prostration, rapid loss of weight, failure to retain fluid even when given in large amounts, a gray color of the skin and acidosis.

In a group of twenty infants suffering from the symptoms described, the mastoid antra were opened under local anesthesia and streptococcus pus obtained: in a large proportion of cases there was an immediate relief of symptoms. The usual signs of mastoid involvement such as swelling, redness and tenderness were absent. The tympanic membrane showed slight change. Sagging of the posterior superior wall was the most common finding. Due to the close relationship that the ear has with the brain, and to the venous and lymph supply, infections may be easily spread to other parts and cause complications or secondary infections. The most common are the complications of acute purulent otitis media.

According to Kerrison, acute suppurative mastoiditis may give rise to: (a) infective sinus thrombosis, (b) epidural abscess, (c) cerebral abscess, (d) cerebellar abscess, (e) acute diffuse suppurative labyrinthitis, (f) acute circumscribed suppurative labyrinthitis, (g) purulent leptomeningitis;

Acute serous labyrinthitis and acute diffuse suppurative labyrinthitis may lead to: (a) epidural abscess, (b) cerebellar abscess, (c) purulent leptomeningitis, (d) infective sinus thrombosis.

Direct infection of jugular bulb rare.

It is therefore very important to examine the ear very thoroughly and especially not neglect the chronic suppurative ears, as these are the most dangerous in type.

NOSE

Focal infections of the nose are generally due to adenoids or sinus infections, but as adenoids are more intimately connected with the tonsils, we will take them up later.

Sinus infections may begin as a direct infection of the sinus or secondary to some intranasal condition, or secondary to an infectious disease such as influenza, enteric fever, measles, scarlet fever, diphtheria and other infectious diseases, especially common colds.

Sinus infections are very common in the various deformities of the nose, as enlarged turbinates, deflected septum, etc., which interfere with their drainage. In about twenty-five per cent of antrum infections the teeth are the cause of the infection.

DRAINAGE OF SINUSES.

Antrum veins drain with the sphenopalatine veins into the pterygoid veins, also those from the anterior surface go to the facial vein, while those from the roof go to the ophthalmic and then to cavernous sinus.

Mullin has shown that lymphatic absorption from the antrum, whether of bacteria or inert substances, is by way of the submaxillary and internal jugular nodes to the lymph duct, which then goes to the great veins of the right side of heart and lungs. Substances reaching the lungs in the pulmonary circulation may of course pass on to left side of heart and general circulation. Absorptions from the tonsils take a similar route.

Ethmoid veins and anterior and posterior ethmoids drain into the ophthalmic veins. Their lymphatics connect with those of the cranial cavity.

Frontal veins join the ethmoidal and sphenopalatine veins, also anastomose with the longitudinal sinus. Their lymphatics drain into the lymph nodes of the neck and also go to the sub-arachnoid space.

PATHOLOGY.

Round cell infiltration, petechial hemorrhages and desquamation, mucosa thickened. The lining epithelium loses its cilia and becomes the squamous type. Glands are generally destroyed, blood supply becomes less, later the bone is affected.

SYMPTOMS.

Headache due to: Swelling of mucosa with pressure or irritation of nerves, direct contact of swollen mucosa, negative pressure in sinus, stasis following obstruction, anything causing acute congestion of skull, disturbances in blood and lymph circulation at base of skull.

DIFFERENTIAL DIAGNOSIS.

Maxillary sinus infections have pain over the frontal bone, same side, at times over the antrum, but most commonly only in chronic cases, also referred to the upper jaw, teeth, cheek, eye and supraorbital region.

Bogginess and congestion of the lower eyelid indicate maxillary sinusitis. An ulcer on the septum opposite the ostium of the antrum indicates an antrum infection.

Frontal depends on size and shape of sinus; patients are unable to think clearly or properly; headaches which remit sometimes during afternoon. Pain distributed over distribution of first division of fifth nerve. Pain in and about the eye, marked pain on pressure over floor of sinus and behind inner canthus: if the third cranial nerve is involved with ptosis and congestion of upper eyelid, the frontal and anterior ethmoids are involved.

ETHMOID.

Ethmoid infections are of two types: chronic hyperplastic with polyp formation, and chronic suppurative. Headaches are not severe, generally a dull pressure, most often over the parietal region, sometimes extending over the temporal in the hyperplastic type, pain being more constant; in the suppurative type pain is more severe, also have pain between eyes directly above root of nose. Dilated pupil, especially if unilateral, and if myopia, glaucoma and ocular diseases are ruled out, then it is due to an infection of the posterior ethmoids.

SPHENOID.

Diffuse feeling of pressure in the occiput, sometimes extending into the mastoid process and even into the temporal regions. Extension downward into shoulder of affected side,

the so-called sphenopalatine syndrome. Pressure varies according to whether sinus is full or partly full; during retention pain is intensely sickening and throbbing synchronous with the heart beat, while during quiescences it assumes more the character of a heavy pressure on vertex. You often have pain below the eye in the region of the infraorbital nerve. Dizziness on stooping is more often associated with pain in the sphenoid than any other sinus. Feeling of splashing within the skull on quick movements of head points to fluid in sphenoid. This sign, however, is very rare.

Prickling sensation at roots of hair is due to pansinusitis. Complications are due to: Relation to orbital cavity, relation to optic nerve, hypophysis medullæ, relation to brain, by way of the blood and lymph stream, swallowing of infectious material.

DIAGNOSIS.

History of case, symptoms, transillumination, X-ray, general appearance of the interior of nose, condition of nasal mucous membrane, presence predisposing factors, condition of lateral nasal wall, presence and character of discharge, location and amount of same, effect of change of posture, effect of shrinking of mucous membrane, presence of polyps, probing, irrigation, bacteriologic examination, condition of tonsils, adenoids and nasopharynx as given by Canfield.

TONSILS AND ADENOIDS.

So much has been written concerning tonsils that most all are familiar with infections coming from this source, so I will take up the "drainage of tonsils" only.

The blood supply of the tonsils is the branches from the ascending pharyngeal and facial, also twigs from the lingual and descending palatine with their accompanying veins, which form a plexus and communicate with the veins of the pharynx.

These vessels to and from the tonsils pass through the pharyngomaxillary fossa, which is funnel shaped; the base of funnel is the base of the skull; the tip is opposite the lower angle of jaw; the carotid sheath emerges at the tip of the funnel and for practical purposes continues the fascia through the neck to the thorax.

The internal boundary is the superior constrictor muscle. The external, the inner surface of the ascending rami of jaw covered by internal pterygoid muscle and part of parotid gland. Posteriorly, by the upper cervical vertebrae covered by prevertebral muscles. This funnel is divided by the styloid process into a large anterior chamber which is in relation to the tonsil, and a smaller posterior chamber containing the internal carotid artery, internal jugular vein and pneumogastric nerve; also near its medial line on body axis there is a lymph node which drains the nose and upper pharynx. It is the node that suppurates in retropharyngeal abscess. The above route through the pharyngomaxillary fossa is the most frequent route that infections take in going from the tonsils into the general circulation. Also through the lymphatics, the upper portion of the pharynx going to the posterior pharyngeal gland, the middle to the superior deep cervical glands, and the lower portion to the inferior cervical glands.

TEETH.

The various dental lesions which may cause diseases in other parts of the body may be divided into those which discharge pus into the mouth and those in which there is no outlet and the mode of transportation of bacteria or toxins is that of metastatic infection. Among the first group belong periapical infections with fistulae discharging pus, oral sepsis from all kinds of unsanitary conditions, especially those connected with poorly fitted crowns and bridges, and pyorrhea pockets from which pus flows into the mouth. The second group includes such conditions as blind abscesses, dental granuloma, pulp infections, less frequently bone infections and infectious cysts.

Dental infections, while potentially harmful, may not cause injury until the individual is subjected to some overload such as influenza, pregnancy, lactation, malnutrition, exposure, grief, heredity, age. Dental infections in the bone may express itself as absorption or increased density of bone.

Dental infections involving root canals and their apices practically always contain strains of streptococci.

Roentgenograms do not always reveal infection and may or may not reveal its effects.

Dental infections may or may not contain organisms with a specific elective localization quality for certain tissues of the body. Dangerous foci are usually painless. Some teeth become sterile by natural methods of healing, though it is not possible always to know when this occurs.

Teeth foci may arise by metastases from infections elsewhere in the body, and thus be themselves secondary foci.

SECONDARY INFECTIONS.

Secondary infections are caused by: Blood and lymph stream, continuity of tissues, defects of bony walls.

EYE.

Hyperemias, infections of lacrimal passages, conjunctivitis, blepharitis, phlyctenular keratitis, photophobia, lacrimation, ptosis, iritis, dilated pupil, asthenopia, intoxication affecting nerves, uveitis, retinitis, orbital abscess, loss of accommodation, glaucoma, diminished fields and cataract.

NERVOUS SYSTEM.

Due to the close connection of the ear and nose with the brain, it may become infected very easily, causing extradural, intradural and cerebral abscesses, neuritis of peripheral nerves, affecting cranial nerves as an intoxication pressure or paralysis, also hysterias, psychosis and neurasthenias.

CEREBRAL SYMPTOMS.

Intense headache, fever, slow pulse, dizziness, vomiting, delirium and convulsions.

EAR.

Tinnitus, eustachian catarrh, deafness, earache, vertigo, purulent otitis.

FACE.

Neuralgias very common of the fifth nerve, face aches, cutaneous affections of face such as eczema of nostrils and abscesses.

CARDIOVASCULAR.

Endocarditis, myocarditis, pericarditis, bradycardia, hypotension or hypertension, thrombosis and phlebitis.

BLOOD.

Low blood calcium content, low red blood cell count, high or low white blood cell count, relatively high lymphocyte count,

hemophilia, bacteremia and glycemia, increase of uric acid, nitrogen retention and products of imperfect oxidation.

RESPIRATORY.

Frequent colds, bronchitis, infection mediastinal lymph nodes, bronchiectasis, pneumonia, tuberculosis, asthma due to anaphylaxis caused by infection, hay fever from the same cause.

DIGESTIVE TRACT.

Gastritis, gastric ulcers, visceroptosis, enteritis, colitis, cholecystitis, pancreatitis, appendicitis due to swallowing infected material from the nose, throat or mouth and through the blood and lymph stream.

Various strains of streptococci found in the nose, mouth and throat seem to have a predilection for the appendix and other tissues of the digestive tract.

GENITOURINARY.

Glomerular nephritis, pyelitis and cystitis are often secondary to focal infections, generally occurring through the blood stream.

MUSCLES AND BONES.

Rheumatism, myositis, arthritis, lumbago, osteomyelitis, periostitis are due to focal infections and effects on metabolism.

ENDOCRINES.

The thyroid is the most often affected, but the adrenals and other glands are often affected, causing fatigue, weakness, worries, irritability, disorders of metabolism, growth, malnutrition, loss of weight, sallow skin and oftentimes subnormal or high temperatures.

DIAGNOSIS.

History including family susceptibility, clinical examination, transillumination, X-ray, bacteriologic examination.

CONCLUSIONS.

Most of the chronic systemic conditions are caused by focal infections.

There should be a careful examination and a very careful history taken of the case before advising any radical procedures.

There are many problems to be solved concerning focal infections, their results on the blood, various tissues and products.

Only through the cooperation of the internist, surgeon, dentist and the specialist can these infections be diagnosed and eradicated.

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LXXIII.

NASAL MANIFESTATIONS OF ALLERGY.*

BY CHARLES H. EYERMANN, M. D.,†

ST. LOUIS.

Pollenosis, or hay fever, is the most frequently recognized type of nasal allergy. The symptoms follow the inhalation of wind borne pollen, but may also be produced by the pollen of insect pollinated plants, if directly inhaled. Insect borne pollen is never found in the air in sufficient quantities to be a factor in the production of hay fever symptoms, but it may precipitate an attack under such exceptional circumstances as when the flower is deliberately smelled, or when grown in great profusion in close contact with the patient or when used for decorating purposes in the home. The fact, that in order to be a potent factor in the production of hay fever symptoms, a pollen must be wind borne, eliminates those insect pollinated plants which many credit with causing the symptoms. In general, insect pollinated plants are characterized by bright colored, conspicuous flowers which have a sweet odor; the pollen is heavy and viscid, and is shed very sparingly. In this manner, one eliminates clover, roses, honeysuckle, dahlia, chrysanthemum, clematis, lilac, white and yellow daisy, sunflower, goldenrod and some fruit trees, and thus the popularly designated rose cold or rose fever is found to be due to the pollen of the grasses, while the symptoms usually attributed to goldenrod are due to the pollen of the ragweeds.

In this part of the United States there are three hay fever seasons: the first season extends from about the middle of March to the middle or last of May and is due usually to the pollen of trees. Oak, maple and willow most commonly give reactions in this vicinity. The next season extends in this vicinity from the middle or late May to the middle of July and

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is due to pollen of grasses. It seems that this season may be subdivided into two short but distinct periods. The first period extends from the middle of May to the middle of June, and appears to be caused by the pollen of June and orchard grasses; the second period begins about the middle of June and extends to the middle of July and is due to the pollen of timothy and redbud.

The next season in this locality begins about the 10th to the 20th of August and extends to the middle of September, and is definitely closed by the first killing frost. The chief offending pollen for this type of pollenosis is derived from either the short or giant ragweed.

There are some cases, however, which do not strictly follow these seasonal limits, the symptoms extending beyond the time of pollination. Such cases are usually multiply sensitive or have secondary infection.

The symptoms of these three types of pollenosis are similar except as to severity. The tree cases have the mildest symptoms, while the ragweed cases have the most severe symptoms. Yet one occasionally sees patients who suffer very much during the period of tree or grass pollination.

"Perennial hay fever," "nonseasonal hay fever," or "atopic coryza" (Coca and Cooke), is not as easily recognized as pollenosis and is most often mistaken for primary nasal disease. In this condition, one has typical hay fever symptoms at times other than those established as hay fever seasons. The difficulty in recognizing these as allergic cases arises from the fact that the symptoms may be mild and of short duration, being considered merely as rhinitis; or in cases of longer duration, lacking the prolonged and explosive sneezing, one fails to be impressed by the edematous nasal blocking and the predominant copious, colorless coryza and, finally, because infections, both nasal and paranasal, which are frequently found in this type of allergy, obscure the clinical picture.

The etiology of this type of allergy, when due to inhalation, is some allergic substance other than pollen, the term pollenosis, or seasonal hay fever, being reserved for cases which are caused solely by pollen. This does not mean, however, that a case at first glance may not appear to be seasonal; as, for

example, the patient who has hay fever every August, whose symptoms are due to horse dander contact at this time, which he has at no other time; or the housewife, whose symptoms occur every spring, the symptoms being due to house cleaning and not to pollenating trees or grasses. It is also a matter of experience that persons sensitive to horse dander, orris root and other animal dander not infrequently are worse in the spring and give a clinical appearance of seasonality. Close clinical analysis will show that the seasonal variation in this type of case is more apparent than real.

The allergic factors in this type of nasal allergy are most frequently air borne substances, as animal emanations, vegetable powders, such as orris root, rice, corn, barley and wheat flour or dusts. The animal emanations include the impalpable dust of feathers, the dander of horse, cat and dog, which is about the frequency in which they are found as etiologic factors. Rabbit hair and goat hair are frequently used for bedding by some people and hence are causative factors, more usually among clinic cases. Rabbit hair is quite a frequent article of commerce, being used in overstuffed furniture, cushions of motor cars, felt materials and at times masquerading as more or less expensive furs.

Orris root is a common cause of this type of allergy; rice powder and cornstarch less frequently. These are found in face powders, talcum powders, tooth powders and any other toilet powders.

Dusts may be considered under occupational dusts and house dusts. The occupational dusts contain the substance characteristic of the type of work pursued by the patient. Among bakers and millers, the cereal grains are frequently responsible. Jeweler's dust contains a large percentage of boxwood; furrier's dust contains many fur particles and dye substances. In druggists, according to Peshkin,¹ ipecac, podophyllin and pokeroot are the most frequent factors. In a druggist recently observed, powdered caroid was found to be the etiologic factor. Spain² mentions hops and barley as causative factors among brewers and dealers in brewers' supplies.

House dusts are composed of lint from cotton, woolen or linen materials used in floor coverings, bedding and clothing;

particles of feathers from pillows and upholstery; of the danders and hairs of various animals, which may be house pets, or as part of the dust brought into the home on shoes and clothing; of the various powders used for toilet or cosmetic purposes; of insect powders; of bits of glue from furniture, and finally of pollen. By cutaneous tests it is often possible to determine which one of these components is responsible for the symptoms in a given individual. When this is not possible, one may be able to show that the dust is specifically responsible by cutaneous tests with an extract of the dust itself.

That dust may be specifically responsible for symptoms in a hypersensitive individual has been shown experimentally by Spivacke and Grove,³ using the method of local passive transfer. Prausnitz and Kustner,⁴ in a case of hypersensitiveness to house dust and horse dander, were able to show that there was a specific reaction to house dust which was not a product of the horse dander.

All the factors we have just considered as causative agents in nasal allergy are those with which the patient comes in contact by inhalation. Comparatively rarely identical symptoms can be produced by ingestion. In the seasonal cases, it is well to remember that there are seasonal foods as well as pollen. Also, there are definite cases of pollenosis who find that their symptoms are aggravated by eating certain foods. As an example, a man of 41 years, afflicted with ragweed hay fever and asthma for many years, stated that he believed the eating of corn aggravated his symptoms. By the intradermal method, in addition to the pollen reactions, an unmistakable positive reaction was obtained to corn and to no other food. In another case, a girl of 19 years, complaining of hay fever and non-seasonal asthma, which was a great deal worse during the hay fever season, and a continual nasal blocking, there was found by the intradermal method positive reactions to potato, pea and the pollen of ragweed. She had had three courses of adequate ragweed desensitization injections without obtaining impressive relief. However, when potato and pea were excluded from her diet, in addition to ragweed injections, there was marked improvement during the ragweed season. This

exclusion diet was continued throughout the year, and she noted considerable alleviation of the nonseasonal blocking.

In the nonseasonal cases, one may see those with more or less constant symptoms due to the frequent ingestion of a food, usually one of the common foods, or the symptoms may be sporadic, due to the infrequent ingestion of a certain food. It is these latter cases that are often considered as only an oft repeated cold. If such "colds" are afebrile, allergy should be suspected. For example, a woman of 54 years complained of nasal blocking, copious nasal discharge and paroxysmal sneezing; these symptoms were present daily and were nonseasonal. She had had adequate nasal attention and was compelled to use cocain to relieve the nasal blocking. By eliminating eggs and all egg containing foods, she became free of her complaint. It has been possible to induce her symptoms by purposeful egg feedings and to relieve the condition by again excluding egg. In another patient, the subject of ragweed hay fever, who, in addition, considered herself subject to frequent colds during the winter, it was found that these so-called colds could be induced by the purposeful eating of almonds. In another patient with nonseasonal paroxysmal sneezing and more or less constant nasal blocking, the eating of beef would be followed in three or four hours by a "stuffy nose."

The ingestion of drugs may also be followed by nasal symptoms. Spain² mentions aspirin, quinin, methyl salicylate or oil of wintergreen and tincture of delphinium. In our own experience, codein in one instance has been followed by a "stuffy nose" on several purposeful trials; and, in another instance, an irritative nonproductive cough and nasal blocking was present during the time of codein administration, and was completely relieved when the codein was discontinued.

There are other factors which will assist in building up the diagnosis of nasal allergy besides the appearance of the nasal mucous membrane and the history of the patient's complaint. A history of similar symptoms or other manifestations of hypersensitiveness, as bronchial asthma, urticaria, eczema, angio-neurotic edema in the antecedents, occurs in about 60 per cent of cases, as noted by Cooke and Van Der Veer,⁵ Spain and Cooke,⁶ Walker,⁷ Adkinson⁸ and others. A history of similar

symptoms or other allergic manifestations in sisters or brothers or children of the patient is also of value. The occurrence of other allergic manifestations in the patient will also assist. At times, by adroit and intensive questioning, one can not only be certain of the existence of allergy, but also, with a reasonable degree of certainty, surmise the offending factor. Frequently there is an eosinophilia in the blood. And finally, the results of cutaneous tests, when properly performed and correctly interpreted, are dependable in establishing the diagnosis of nasal allergy.

The cutaneous tests, however, are not infallible. Certainly there are patients who conform to the clinical criteria of hypersensitiveness in whom it is impossible to obtain unmistakably positive cutaneous reactions. In the hands of the allergists, only about 50 per cent of clinically suspected allergic cases give positive cutaneous reactions. With this in mind, and to add perhaps another diagnostic measure which might be of value in determining the existence of the allergic state, a study of the cell content of the nasal secretion was made.

The secretion was obtained from patients who had a nasal complaint in addition to their presenting symptom. In most instances the secretion was taken from wherever it was visible, usually the anterior tip of the middle turbinate. For some of the secretions we are indebted to Dr. A. W. Proetz, Dr. J. B. Costen and Dr. F. K. Hansel, in which instances the secretions were taken from a definite locality, as the middle meatus, the sphenoid area, etc.

Smears were taken in duplicate and one stained with the ordinary Wright's stain (polychromate of methylene blue), using the same technic as used with blood smears, and the second smear stained with hematoxylin and eosin, using the technic for fixed tissues. Both stains differentiate the eosinophiles very well, but the Wright's stain does not always differentiate clearly if there is an excess of mucus present.

Dr. L. D. Thompson, in charge of the clinical microscopic laboratory of the Department of Internal Medicine, studied these smears and reported as follows:

Three types of cells were identified: first, the ordinary pus cells or polymorphonuclear neutrophile; second, the eosino-

phile, characterized by a bilobed pale blue nucleus, and many large eosinophile granules, and third, a group of cells which we believe are epithelial in origin. These cells vary in size and shape, the nucleus usually being large and oval, with an irregular network arrangement of chromaffin material and containing one to two nucleoli. These cells are found in various stages of degeneration, some with small pyknotic nuclei and some with marked eosinophilic staining qualities of the cytoplasm. Such cells might be confused with eosinophiles, but no cell was identified as an eosinophile unless the granules were distinct and the nucleus characteristic. Occasionally such cells with pyknotic nuclei are found to be filled with micro-organism. Still a fourth type of cell has been found which we believe to be the mononuclear phagocyte, but no special attention has been paid to it. The manner of reporting the relative proportion of the cells found is as follows:

Many—more than ten cells per oil immersion field.

Few—less than ten cells but at least one per oil immersion field.

Occasional—two or three cells seen after a search of many oil immersion fields.

In this manner the nasal secretion from 91 patients was examined. Fifty-nine cases of this group are definite hypersensitive cases, as shown by positive skin reactions or by classical clinical criteria. Of this group of 59 hypersensitive cases, 43, or 72 per cent, showed the presence of eosinophiles. In 14 of these cases, or 32 per cent, there were ten or more eosinophiles to the oil immersion field; in 12, or 27 per cent, there were from one to nine eosinophiles per oil immersion field; in the remaining 17 cases, or 39 per cent, two or three eosinophiles were found after a search of several oil immersion fields.

Of the 91 patients examined, 32 were considered as non-sensitive individuals. In only 3, or 9 per cent of this group, were eosinophiles identified in the nasal secretion. Of these three, two were classified as few, and the other one as occasional. In this small series, then, it is found that eosinophiles are present in the nasal secretion in 72 per cent of allergic individuals, as contrasted with 9 per cent in nonallergic individuals.

While this study obviously deals with too few cases to yield a statistical conclusion, it is believed that it lays emphasis on a somewhat neglected aspect of nasal pathology, namely, the recognition of the cell content of the nasal secretions. Inasmuch as the eosinophilic reaction is generally recognized as a phenomenon of allergy, it is possible that the cytologic examination of the nasal secretion will help not only to differentiate nasal allergy from other nasal conditions, but may also assist in eliminating the element of doubt in obscure cases.

In conclusion, I would point out that it has been the advances in the field of allergy that have made the diagnosis of nasal allergy more certain and its identification more frequent. Much more, however, needs to be learned concerning this particular phase of allergy, and it is to those whose interests are specifically in nasal pathology that we look for this increase of knowledge.

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LXXIV.

TRICHLORACETIC ACID IN THE TREATMENT OF
ULCERATIVE LARYNGEAL TUBERCULOSIS.

BY BERTRAM C. DAVIES, M. D.,

LOS ANGELES.

In presenting this report of a new treatment for tuberculous ulceration of the larynx, a preliminary review of the multitude of therapies to which this affection has, in the past, been subjected has been purposely omitted, as well as a discussion of the percentage of patients so affected. This is simply a record of the results of this particular method of treatment. During a period of six months, 42 cases were seen, ranging in age from 14 to 62 years.

Dysphagia is often the barrier which prevents the recovery of tuberculous patients. Such individuals must be fed, but when swallowing is accompanied by intolerable pain, or made impossible because of an ulceration in or about the larynx, they refuse food and the fight is lost.

A review of the literature carries one through the gamut of such forms of therapy as inhalations, sprays, insufflations, pigments, actual cautery, injections and surgery. All of the different methods have had their champions for a time. Some have apparently produced favorable results under certain conditions. As a rule, however, they are too slow in their action, resulting in the patient losing ground too fast, waiting for the dysphagia to be overcome, and dying from malnutrition.

In the Laryngeal Clinic of the Los Angeles General Hospital, the treatment instituted by Dr. Benson Wood (chaalmoogra oil, 20 per cent, in olive oil, applied to the larynx) is producing real results and is undoubtedly a big advance over any previous treatment of ulcerative tuberculous laryngitis. In many instances, however, the results are obtained too slowly to prevent starvation because of the dysphagia.

During the past two years the writer has been using acid trichloroacetic pura in the treatment of Vincent's angina. In

this disease it was found to give the best results in producing a clean field with rapid granulation. Five months ago this treatment was used on a patient, 64 years of age, affected with a tuberculous ulceration on the posterior surface of the epiglottis. The patient was much emaciated because of the very severe dysphagia. The ulceration was cleaned first with peroxid, followed by an application of acid trichloracetic pura. Application was made with a curved wooden applicator, no cotton being used. The patient said that there was no pain but a sense of heat which passed immediately. Within 48 hours the ulcer was seep to be clean and already filled with granulations. The pain was gone and she could swallow any kind of food or drink. She has since gained markedly in weight, and a cough, which was present at that time, has stopped.

In all, 38 patients in the Los Angeles General Hospital and four private patients have been treated, with results uniformly good. The ulcerations healed promptly, and they were able to swallow in comfort.

The location of the ulceration does not influence the treatment in any way. The acid is easily applied, and frequent applications are not necessary. No routine is followed as to a definite interval between treatments. They are given as indicated by the character of the ulceration. As a rule, all that is required, after the first application, is a touching up of small areas that have not been as prompt in granulating as the rest. With subsequent applications these areas are stimulated and become even and smooth.

The applicator used is the ordinary seven inch wooden applicator. These are boiled in the sterilizer and while yet hot are moulded into the regular curve of a laryngeal applicator. For this purpose, we make the outline with long finishing nails, on a piece of inch board, using a double row, leaving room between the rows for the applicator. When they are dry they retain their curvature and may be used in the regular laryngeal mirror handle.

When complete coverage with granulations has taken place, it is a good practice to make regular applications, twice a week,

of chaulmoogra oil, 20 per cent, in olive oil, in order to establish fibrosis and thus render the area firm and hard. As a rule, this oil is used for two months.

The action of acid trichloroacetic is escharotic. The tubercular ulceration is a broken down miliary tubercle, now filled with detritus, which is very hard to penetrate. Pus and bacteria form a combination which perpetuates the ulcer and permits it to enlarge.

This mass is rapidly penetrated by the acid, and instant coagulation takes place down to normal tissue, causing the mass to slough within a few hours, leaving a very clean, even surface.

Following this process, granulation tissue begins to form within a very few hours, eventually covering the ulcer completely. Not more than four treatments have been given to any one ulcer in order to produce repair of the ulcerative area and eliminate the dysphagia.

There is no local inflammatory reaction following treatment, and the action of the acid is strictly confined to the ulcer. As many as eleven miliary ulcers in the larynx have been treated at one time without distressing the patient. The very small ones disappear without forming granulation tissue.

In the treatment of Vincent's angina with ulceration of the tonsil, no more than two treatments have been found necessary to produce a clean and completely granulated field.

The following cases are mentioned as typical:

<i>Location of Ulcer.</i>	<i>Treatment Date</i>	<i>Result.</i>
1. Left ventricle }	Aug. 1, 1926	Very painful deglutition.
Lateral surface }	Aug. 13, 1926	Pain gone; ulcer clean.
Left arytenoid }	Sept. 6, 1926	Granulation started.
		Healing complete.
2. Transverse quarter inch below tip of epiglottis, posterior surface....	Sept. 5, 1926	Extreme pain on swallowing.
	Sept. 28, 1926	Much pus. Very little pain.
		Ulcer much cleaner. Granulating except right end of line
	Oct. 1, 1926	Granulation slow right and
	Oct. 15, 1926	ulcer quite clean. No pain.
	Oct. 21, 1926	Granulation complete.

3. Ventricle near right vocal process	Sept. 24, 1926	Painful deglutition; ulcer very dirty.
	Sept. 28, 1926	Granulating; much less pus.
	Oct. 1, 1926	Granulation complete.
4. Lateral surface.....	Sept. 28, 1926	Painful deglutition; much pus.
	Oct. 1, 1926	Ulceration cleaner; beginning granulation.
	Oct. 12, 1926	Granulation complete.
	Oct. 26, 1926	Healing complete.
5. Posterior surface near tip of epiglottis	June 8, 1926	Unable to swallow anything but liquids.
Considerable pus.....	June 11, 1926	Eating comfortably; ulcer clean and granulating.
	June 22, 1926	Eating well and gaining in weight; granulation complete.
	Oct. 26, 1926	Granulation holding and fibrosis increasing.

I am unable to find any previous mention of the acid used in full concentration on tuberculous lesions. To date we have not had one case fail to respond. These uniformly excellent results, obtained in the present series, prompt me to bring this method of treatment to your attention in order, if possible, to encourage further confirmation of the efficacy of this form of therapy.

LXXV.

ALLERGY AS RELATED TO OTOLARYNGOLOGY.*

By W. W. DUKE, PH. B., M. D.,

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Since the suggestion of Weichardt and of Wolff-Eisner in 1905 and 1906, that hay fever seemed to be related to animal anaphylaxis, and since the suggestion of Meltzer that bronchial asthma was a phenomenon of anaphylaxis, the subject of hypersensitiveness in humans as it affects the nasorespiratory tract has grown to large and important proportions. There is marked similarity between animal anaphylaxis and a peculiar type of hypersensitiveness in humans. Whether or not the phenomena in animals and humans are identical, however, has not yet been conclusively proven. Suffice it to say that they are remarkably alike in many respects. Most striking are the facts that in each an apparently harmless substance, such as an ordinary foodstuff, can, to a sensitive animal or human, rank with the most violent poisons known to medical science, and that in each condition almost every tissue and organ in the body is affected to a greater or less extent in a characteristic way. Few tissues are immune to the effects of reaction. Since surface tissues in humans come in contact with foreign agents more frequently than do the internal structures, it is surface tissues, such as the mucous membrane of the nose and bronchial tubes, gastrointestinal tract and the skin, which are most frequently involved by reaction.

NATURE OF AGENTS WHICH SENSITIZE.

Apparently, an almost unlimited number of agents can sensitize a human and cause reaction. A serious effort has been made by many observers to determine, if possible, the nature of agents which tend to sensitize. Some little progress has been made in this line. Certain amines and tyramine, for example, can cause reaction in untreated animals or normal hu-

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mans if given subcutaneously. The reaction is very much akin to that which follows a pollen injection in a pollen sensitive individual. Drugs of the morphin series likewise have a tendency to cause a hive reaction if injected intracutaneously. Morphin, if given in dilute solution intracutaneously in normal individuals, causes a characteristic hive in practically every case. This is not true of other drugs, such as drugs of the cocain, atropin and quinin series. I tested intracutaneously a relatively large number of normal and allergic individuals with some twenty drugs and hystamine, and obtained positive reactions in relatively few, except with hystamine and drugs of the morphin series. It appears that an additional factor of mode of contact with foreign agents is a very important factor, though perhaps less so than the nature of agents which sensitize. For example, patients do not ordinarily react to substances which are met with frequently in gross amounts, such as the larger protein constituents of eggs, milk or the commonly eaten meats. They react rather to substances which are rarely met with, or substances which are met with commonly but in almost infinitesimal amounts. For example, several patients who reacted to beef extract proved to be sensitive to a constituent contained in beef in slight traces only and which would stand boiling. They were not sensitive to the grosser proteins. Several cases who were sensitive to milk were apparently sensitive to none of the common constituents of milk but to the article of food eaten by the mother or animal furnishing the milk. If a human were highly sensitive to the substances met with in gross amounts, the patient would either succumb or gain tolerance. Patients who are sensitive to pollen, of course, meet with only traces of pollen under normal conditions. They do not meet with enough pollen to give them tolerance. Our method of treatment, on the other hand, depends upon the systematic giving of pollen in ascending doses until the patient gains tolerance and becomes able to handle the quantity which he meets with naturally. Slight surface contact with pollen is changed by treatment to gross intimate contact.

TYPES OF REACTION.

An important distinction must be made between two types of reaction, namely, reaction in the nasal or bronchial mucous

membrane, which is the result of direct contact between the membrane and some air carried substance, and reaction in the same membranes occurring as a result of a constitutional reaction to some substance which has been absorbed and distributed by the general circulation. A food can cause reaction in either way. For example, egg eaten by mouth may either cause reaction through emanations reaching the nasal passage during a process of mastication or may cause reaction after partial digestion and absorption from the gastrointestinal tract.

TOXICITY OF AGENTS WHICH SENSITIZE.

Very few physicians except those who have had actual experience can appreciate the high grade of sensitiveness which afflicts some individuals. To certain individuals, there is no poison known to medical science, except diphtheria toxin and tetanus toxin, which can act in such minute traces as a substance to which the individual is sensitive. The infinitesimal trace of the substance which can cause reaction can hardly be measured. For example, in a pollen sensitive case, I have known one-ten-thousandth of a milligram of crude pollen to cause reaction. If the active substance in pollen responsible for reaction could be purified and used, I am sure that the quantity which could cause reaction would be reduced to one one-millionth of a milligram or less—that is, one one-billionth of a gram. This should seem small to anyone. However, this fact can be illustrated possibly more practically by the citation of several illustrations. I recently observed two cases of egg dermatitis, for example, in children, who had been subject to eczema on the exposed parts for several years. They had been treated by several capable physicians and were sent to me with the correct diagnosis of egg dermatitis. In one case the mother had realized that egg caused illness and had carefully removed egg from the child's diet. In each case several physicians had instructed the mothers to strictly keep the children out of contact with egg. On an egg free diet, under my care for several months, neither child showed improvement, and unsuccessful efforts were made to find some substance other than egg to which they might be reacting. In one case I lost patience with the mother, and told her I did not believe she was keeping the child on an egg free diet, and told her to keep eggs out of

the house. She took me at my word and returned later with a perfectly normal well child and a story that the dermatitis began to clear up from the day she kept eggs out of the house. She found that if either she or the father handled egg or ate egg while away from home, the dermatitis would return when they handled the child. I immediately told the mother of the second child to follow the same procedure, with the result that the second child cleared up completely within a few days. Dr. Gerald B. Webb and Dr. Ray Matson have each cited to me an example of an egg sensitive case who could not eat hen meat without discomfort but could eat rooster meat. I have been able to verify their observations in several cases. The trace of egg in hen meat can actually cause a severe illness. I have observed cases sensitive to honey who would react with a violent gastrointestinal attack after the ingestion of one drop of honey. The patients, however, were not sensitive to honey of every type but only to that derived from certain plants.

THE HEREDITARY CONSTITUTION AND ITS INFLUENCE UPON IMMUNITY.

Human hypersensitiveness is consistently a hereditary condition. One might almost say that without heredity human hypersensitiveness does not exist. This may be an exaggeration. A positive family history can be obtained in over half the cases of real pollen hay fever or asthma. If the families of hay fever cases are tested cutaneously, the percentage exceeds this. In other words, many patients have the tendency to hypersensitiveness but do not actually have clinical symptoms which attract their attention. Individuals of allergic strain seem to belong, one might say, to a different race than that of nonallergic individuals. Their reactions are different. They are different not only in relation to reaction to material agents to which they may be sensitive, but also their reactions of immunity are different. Even their reactions to certain sensations, such as pain, heat and cold, are different in a fairly large percentage of cases. Even their mental reactions to certain emotions are different in a rather large percentage of cases. For example, some individuals can hardly tolerate the pain caused by an intracutaneous injection of pollen, nor can others hardly tolerate the pain caused by the heat of a nitrogen lamp, even though the heat produced would hardly exceed that

which the ordinary individual would call warm. Others can hardly tolerate the sense of cold on the skin. Others react to certain sensations of fear or worry which would hardly concern the normal individual. The phenomenon of altered reactivity is by no means confined to such tissues as the nasorespiratory organs, but may involve the nerve cells as well.

I have found that among the seasonal pollen cases there is a high grade immunity to both tuberculosis and syphilis. Among perennial cases we have a little different condition to deal with. These individuals, like the pollen cases, have a high grade immunity to tuberculosis and syphilis, but, unlike the pollen cases, are more than normally susceptible to acute infections of the nasorespiratory tract, such as sinusitis and bronchial pneumonia. Among 500 cases of hay fever, asthma and hives, which were carefully tabulated, only nine had active syphilis. (This is a much smaller percentage than is found among nonallergic individuals.) All responded well to therapy and not one single case had evidence of *tabes dorsalis* or paresis. In fact, in my entire experience with allergy cases on whom complete physical examinations and Wassermann tests were made as a routine, *tabes dorsalis* of mild grade was found in only one case.

Among the same 500 cases, in whom lung examinations were made carefully as a routine, only seven proved to have active tuberculosis. In an additional three, tuberculosis was suspected but not proven. Of the seven cases who had active tuberculosis, all were cases of long standing and rarely confined to bed. Only one case of tuberculosis observed during a period of ten years terminated fatally, and this one of a cardiac death as a result of embarrassed pulmonary circulation.

THE RELATIONSHIP BETWEEN CHRONIC REACTION, POLYPS AND SINUSITIS.

Other conditions commonly found among the perennial cases which were not characteristic of the seasonal cases were achylia gastrica, obesity, hypertension and hypotension. Of particular interest also among the perennial cases is the fact that 24 per cent of 500 cases had nasal polyps, and 27 per cent definite, unmistakable evidence of chronic nasal sinus infection. This ratio is quite different from that found among the

seasonal cases, in which polyps were demonstrated in only 10 per cent of cases, and chronic nasal sinus infection in only 6 per cent. Inasmuch as deviated septum was found in about one-third of each of these series of cases, this difference in statistics could not be accounted for through this agency. It is believed that chronic edema of the membranes of the nose continued throughout the year for several years can lead to the formation of polyps, and that the mechanical obstruction caused thereby can predispose to infections, acute or chronic, in the nasal sinuses or bronchial tubes. Chronic edema may account for the high percentage of polyps and infection in perennial cases. The same cannot be said of seasonal cases, even though edema of the membranes may be more marked. It is believed that in seasonal cases the membranes regain normalcy during the well period, even if the illness continues for many years.

AGENTS WHICH SENSITIZE AND CAUSE REACTION.

The various elements which tend to sensitize and cause reaction have been freely discussed in medical literature and need only be mentioned at this point. The more important are the pollens, emanations of animal or vegetable matter of many varieties, smoke, dust, foods, drugs, insects, therapeutic sera and physical agents, such as light, heat, cold, mechanical irritation, and in the case of heat sensitiveness, mental or physical activity. Of the physical agents, heat and cold are the more important, so far as otolaryngology is concerned. Many cases of nasal reaction which do not respond to material agents will be found, if tested, to respond to the effect of heat or cold or to the combined effect of the two. The symptoms which appear seem exactly the same as those caused by sensitiveness to material agents, and, strange to say, may be either perennial or seasonal. I feel inclined to discuss this phase of our subject too freely and for this reason dismiss it at this point.

DIAGNOSIS.

The symptoms of reaction are no doubt familiar to all of you and need not be dwelt upon. The same may be said concerning diagnosis, although I believe the majority of physicians who have had only slight acquaintance with the subject over-

emphasize the importance and reliability of skin tests. Those who believe that cutaneous tests give anything more than a clue to a diagnosis are destined to many disappointments and many mistakes. A diagnosis can be made with definiteness only by finding that relief of symptoms follows removal of the patient from contact with the suspected agent, and that symptoms can be again elicited through again bringing about natural contact between the patient and the suspected agent. Even this is not conclusive proof and shows only a location of the agent. This is the best we can do at the present time.

TREATMENT.

Treatment, of course, is of primary interest to all of us. Avoidance of the cause is, of course, the best and usually the simplest when this can be accomplished. If the cause cannot be avoided, specific treatment with the agent primarily responsible for the illness can be highly recommended. In the case of contact reaction between a surface membrane and something coming from the outside (as in pollen disease), the result is almost always good, if not perfect. Failure to get a good result should make one suspect either an error in diagnosis or a multiple cause for the illness. I have found this to be a fact with almost every case treated within a period of two years.

The routine fifteen dose methods given at specified intervals, recommended by some of the commercial houses, deserve to be condemned in strong terms as ineffective in a majority of cases and actually dangerous. The response to pollen is not the same in all individuals, so that the rate of increase in dosage and the time interval has to be varied according to degree and time of response, also the ultimate dose has to be varied not only according to the reaction of the patient but according to the pollen content of the air in the district in which he resides. Even this varies in different seasons. Specific treatment with foods is not nearly so successful as treatment with pollen. This is probably due to the fact that we are not always able to find and use the actual substance in the food which is responsible for the illness. Nonspecific and vaccine treatment has not seemed of much service in my experience.

although in rare instances a temporary good result can be obtained. Symptomatic treatment with adrenalin, ephedrin, atropin, acetyl salicylate is useful for temporary relief. I am not sure but that prolonged use of adrenalin several times daily over a period of years is undesirable. It seems to so accustom a patient to its use that it is difficult to relieve the patient by other means if adrenalin is discontinued. Habit forming drugs and anesthetics are contraindicated except in case of the gravest emergency. The morphin habit is much more easily acquired by allergy patients than by the average individual, and, once acquired, is more difficult to relieve.

NASAL SURGERY IN PERENNIAL CASES.

Finally, a word should be said concerning surgery in the case of nasal allergy or bronchial asthma. The allergic individual is different from the normal, and has to be handled differently, both medically and surgically. This does not apply particularly to the removal of tonsils, and possibly only to a small extent to careful septal operations when indicated. Even in the latter case, however, I have observed patients with perennial nasal allergy to be thrown into a state of chronic bronchial asthma after a septal operation which was done with perfect technic and which was strongly indicated. It is possible that cases of this sort may be explained through some variation in the cooling or drying of the membranes of the bronchial tubes following a widening of the nasal passages. Surely it is difficult to account for otherwise. Operations on the turbinates and sinuses should be done with distinct fear in an allergy case. This may not apply to seasonal cases but most certainly does apply in perennial cases. Perennial cases have a natural tendency toward edema of the membranes and polyp formation. The removal of polyps does not remove the cause of trouble, and operation on the sinuses rarely relieves the condition except for the time being. Frequently it leads to more and more operations and more polyps and often to chronic infection. Patients with an allergic nose have not the tendency toward perfect healing and recovery of normal membrane structure that is possessed by the normal individual, and the result is very often harm instead of good.

THE USE OF SERA IN HAY FEVER AND ASTHMA FAMILIES.

Finally, a word should be said concerning the use of sera in hay fever and asthma cases. The otolaryngologist is no doubt frequently called upon to either use sera or advise its use in the case of diphtheria. Patients with hay fever and asthma have a natural tendency to react to substances given intravenously, whether the substance be salvarsan, transfusion of blood or serum. Lamson, in an exhaustive review of the literature, reports the finding of a history of hay fever or asthma in 34 per cent of the cases of death reported following the use of antitoxin. If a careful inquiry into the personal and family history of hay fever and asthma had been made in each of the cases reviewed I think we can rely on the fact that this percentage would be grossly higher. It is hardly justifiable to give a prophylactic dose of antitoxin to a hay fever, asthma or hive case in the case of exposure to diphtheria. It is better to allow the patient to chance contracting the disease. Furthermore, it is hardly justifiable to give a prophylactic dose of tetanus antitoxin unless very strongly indicated. The disease diphtheria, of course, almost necessitates the use of antitoxin. When given therapeutically, however, it should be given according to a special technic recommended by Coca, and the dose administered should be reduced to the minimum.

LXXVI.

HYPERESTHETIC RHINITIS AND MYXEDEMA.*

BY FRANK J. NOVAK, JR., M. D.,

CHICAGO.

Numerous theories have been advanced to explain the nature of the condition known as hyperesthetic rhinitis, which is also designated as vasomotor rhinitis, hyperplastic rhinitis, hyperplastic ethmoiditis and nonseasonal hay fever. Some writers base their opinions regarding the etiology on the symptoms, while others draw guarded conclusions from the underlying gross nasal pathology.

Although these views differ widely, there is a well known tendency in a considerable number of the recent writers on the subject to seek the underlying cause of the condition in what is looked upon by some as the fanciful field of endocrinology. The writer shares in this tendency and presents some evidence deduced from the careful study of twenty cases, which, it is believed, will strengthen the assumption of the endocrine nature of the condition. Although the evidence is inadequate as positive proof of the dependence of one condition upon the other, the association of hyperesthetic rhinitis in these cases with endocrine, especially thyroid, imbalance seems to be so clear as to compel one to believe that there is a relationship between hyperesthetic rhinitis and thyroid myxedema; in fact, that the rhinitis may be considered as part of the myxedema syndrome. In support of this contention, the views of others, who also apparently accept the idea or theory of the endocrine origin of hyperesthetic rhinitis, will be cited.

In view of the controversial nature of the subject, it is well to define terms as accurately as possible, at the risk of repeating what is already well known and clearly understood.

Osler¹ defines myxedema as "A chronic disease characterized by trophic disturbances of the skin and subcutaneous tissues and by cachexia and mental disturbance due to loss of thyroid

*Presented as a candidate's thesis to the American Laryngological, Rhinological and Otological Society.

function." In another place the same author,² discussing the symptoms of myxedema, gives among them, inelastic swelling, roughness and dryness of the skin, local tumefaction of the skin and subcutaneous tissues, broadening and thickening of the nostrils. The thyroid gland is diminished in size; it may be completely atrophied and converted into a fibrous mass; in some cases a great increase in mucin has been found in the subcutaneous tissues.

In an article published in 1921,³ concerning the basal metabolism in hyperesthetic rhinitis, the following clinical description of it was given by the writer: "It occurs most commonly in young females, although it is also observed in older women and in the male. The attacks come on regardless of the season of the year, without exposure to perfumes, odors or irritating vapors. They usually occur in the morning, after arising, and are characterized by paroxysms of sneezing, which have been referred to as the "machine gun sneeze." The patient sneezes from a half dozen to fifty times in one paroxysm. This is followed by a profuse, thin, watery, serous, irritating discharge from the nose, soiling several handkerchiefs. The conjunctivæ become more or less suffused and hyperemic. There may be only one attack. In the severe cases the attack may be repeated many times during the day. In the milder cases the disease may be only mildly annoying to the patient. In the severe cases the disease may lead to profound mental depression of the patient, and be the source of a great deal of worry.

"This mental state of the patient is of interest, and is, perhaps, of considerable significance and importance in the study of the condition. These attacks may continue for weeks and then subside, and again they may last for many years.

"Upon examination of the nose between attacks, we find that it appears practically normal except for pallor of the mucosa. During the attack and for a variable length of time afterward, the turbinates and the mucous membrane lining the septum are waterlogged. The tissues are pale, soft and swollen. The thin serous discharge gives them a shiny appearance."

The following table of twenty cases of hyperesthetic rhinitis treated by the writer exhibits to a greater or lesser degree most of the peculiarities noted in the foregoing description:

Name	Age	Sex	Symptoms	Duration	Aver. Temp.	Aver. Pulse	B. M. R. Before Treatment	B. M. R. After Treatment	Results
V. B.	34	F	Sneezing, discharge	8 mos.	99.2	84	-12	0	Cessation of symptoms
Mrs. E. L. H.	30	F	Sneezing, discharge	2 yrs.	97.6	80	-3	0	Cessation of symptoms
Mrs. C. T. L.	50	F	Sneezing, discharge	4 yrs.	97.6	72	-22	-4	Cessation of symptoms
G. E. M.	30	M	Sneezing, discharge	1 yr.	96.8	56	-20	-3	Slightly improved
Mrs. O. M.	40	F	Sneezing, discharge	2 yrs.	98.2	76	-23	0	Cured
R. N.	4½	M	Sneezing, discharge	2 yrs.	a	b	-12	0	Cured
Miss A. O.	21	F	Sneezing, discharge	3 yrs.	98.6	72	-12	0	Cured
Mrs. E. P.	35	F	Sneezing, discharge	2 yrs.	98.0	64	-7	+20	Cured
Mrs. J. R.	30	F	Sneezing, discharge	1 yr.	99.0	84	-9	6	Much improved
Mrs. J. P. W.	40	F	Sneezing, discharge	Long time	98.4	96	-11	0	Cured
Mrs. O. B. N.	28	F	Sneezing, discharge	6 mos.	98.8	86	+5	+10	Cessation of symptoms
Mrs. N. S. H.	38	F	Sneezing, discharge	3 yrs.	98.9	70	-12	0	Cessation of symptoms
Dr. R.	40	M	Sneezing, discharge	10 yrs.	f	?	-1	?	Entirely relieved
Mrs. I. O.	50	F	Sneezing, discharge	3 yrs.	98.6	72	-1	-5	Entirely relieved
Miss M. T.	24	F	Sneezing, discharge	2 yrs.	98.0	68	-18	-3	Cured
Miss M. F.	19	F	Sneezing, discharge	1 yr.	97.6	78	-3	+2	Symptoms disappeared
Mrs. R. W.	23	F	Sneezing, discharge	10 mos.	98.4	76	-1	?	Myxedematous condition much improved
J. S.	8	M	Cretinism, hyperesthetic rhinitis	?	?	?	?	?	Hyperesthetic rhinitis cured
V. A.	6	F	Cretinism, hyperesthetic rhinitis	?	?	?	?	?	Myxedematous condition much improved

* B. M. R., abbreviation for basal metabolic rate.

† The basal metabolism test done on Mrs. R. W. was not done under basal conditions. This was not known to us at the time.

a Subnormal.

b Irregular.

c Not done.

d Not done.

e Variable.

f No record.

NOTE: The treatment of all these cases consisted of the administration of Thyroid extract. (Hynson, Westcott & Dunning.)

I would especially emphasize the constant low basal metabolic rate, the pale, patulous, swollen nasal mucosa, the fact that these patients usually showed the clinical characteristics associated with hypothyroid secretion and that nearly all were relieved of their nasal symptoms by opotherapy.

The following history is typical of those tabulated above. The patient is a woman of fifty. She is overweight, soft, flabby, blonde. For the past six years she has suffered from frequent attacks of sneezing (paroxysms of forty or more sneezes) and the discharge of copious amounts of thin, watery secretion from the nose. She underwent a partial bilateral middle turbinectomy and ethmoid curettage four years ago.

Examination: Ears normal. Nose, right, (1) evidence of turbinate operation; (2) mucosa pink, except in region of middle meatus, where it is pale and boggy; (3) clear, thin, watery secretion in nose; (4) no polyps, no pus; (5) septum straight, no spurs, etc.; (6) inferior turbinate boggy. Left: (1) evidence of turbinate operation; (2) mucosa of entire nasal chamber very pale; (3) thin, watery secretion in nose; (4) no polyps or pus; (5) septum normal but pale; (6) inferior turbinate is hypertrophied. Pharynx normal except for dilated capillaries on postpharyngeal wall; tonsils atrophied. Larynx, mucosa pale.

General: Pulse, average 72. Temperature, 98.8° F. The temperature is generally subnormal, but during one period of five days during a "cold" the average temperature was brought to normal by a temporary hyperpyrexia.

COMMENT.

In this case the basal metabolism was low. On certain occasions the rate was as low as minus thirty. Upon the administration of thyroid extract, grains one-fourth, three to four times per day, the metabolic rate was increased, and paralleling the increase in the rate of metabolism a subsidence of the symptoms was noted. When the basal metabolism reached normal the symptoms, sneezing, watery discharge and mental depression, disappeared. At this point thyroid medication was stopped. After the lapse of three or four months the symptoms returned and the basal metabolic rate was again found to be low. Thyroid medication was resumed and the symptoms once

more disappeared when the basal metabolism reached a point within normal limits. This required a period of eight to ten days, when the patient was again free from her symptoms. She has been under observation for over two years, and it is necessary to keep her metabolism up by the periodic administration of thyroid extract, in order to keep her free of symptoms. This case is typical of those summarized in the preceding table, although it shows in a much more striking manner than most of them the dependence of the patient's well being upon the rate of her nasal metabolism. It should be noted in this case, as well as in the others, that there were times during the period of two or three years when the administration of thyroid extract apparently failed to improve the symptoms, but on investigation it was found that the thyroid extract had been purchased at a corner drug store, where it had lain on the shelves for a long time and had become inert.

In studying the literature to see how far the writer's view of hyperesthetic rhinitis with a myxedema syndrome as an expression of endocrine disorder is shared by other observers, it is noted that the etiology of myxedema is generally attributed to insufficiency of thyroid secretion, although Berard⁴ and Ochsner⁵ implicate the parathyroids. Part of the syndrome which translates thyroid dysfunction is expressed by cutaneous and mucous membrane disturbances and by a lowered basal metabolism rate.

In regard to the skin and mucous membrane involvement, Hutinel and Mailliet,⁶ in treating of glandular dystrophies, refer especially to the tegumental changes in myxedema. They note that the cell elements of the skin are infiltrated by fat and by a substance analogous to mucin; also that the three elements—myxedematous infiltrations, surcharge of fat, and tendency to sclerosis—are the origin of the dermal alteration, especially in glandular dystrophies dominated by thyroid insufficiency. Berard⁴ states that in myxedematous subjects at autopsy the most habitual lesions consist of infiltrations of the tegument and the mucosa by mucin; in thyroid myxedema the cutaneous dystrophy and edema is not accomplished by intellectual deficiency, while in parathyroid myxedema it is. McCarrison,⁷ in the histologic examinations of a section of myxedematous skin, also observes that the skin and mucous membrane were

infiltrated by a substance resembling mucin, and that the mucous membrane of the nose was similarly affected. Lortat-Jacob and De Gennes⁸ state that in myxedema the endocrine disturbance apparently determines the appearance of skin and mucosal lesions, which resist all treatments except opotherapy. Leopold Levi and Rothschild⁹ say that patients with hypothyroidism are especially affected by the least disturbance of external temperature (coryza). The mucous membranes are pale, opaque and may be swollen like the skin, which is most obvious in the mouth and nose. The mucosa of the hypothyroid subject is most easily infected or autoinfected.

As regards the basal metabolism, it is well known that the rate is greatly decreased when the thyroid secretion is deficient, as in myxedema, etc. It remains to be shown what clinical or other support there is that hyperesthetic rhinitis is accompanied by a decreased metabolic rate. The writer refers to his own original communication on this subject, published in 1921, which has since been supplemented by the observations of others. Selfridge¹⁰ refers to certain cases of disturbed metabolism in respiratory conditions of undoubted endocrine origin. In a previous article, Selfridge¹¹ mentioned several cases of vasomotor rhinitis, which he considered to have an endocrine basis. He thinks that this condition particularly is related to disturbances in the functions of the autonomic system, and that there is slowly accumulating evidence that the ductless glands play a part in this disturbance.

Lee¹² mentions two cases of vasomotor rhinitis with very low basal metabolism and the usual symptoms of hypothyroidism, both of which markedly improved under thyroid therapy. Sonnenschein and Pearlman,¹³ on the other hand, doubt that lowered metabolism is present in hyperesthetic rhinitis. In four out of five cases observed by Simpson,¹⁴ the basal metabolism was normal; in the fifth case the basal metabolism was below normal and the symptoms ceased on thyroid therapy. Sonnenschein and Pearlman¹⁵ say that it has been definitely shown that a lowered metabolism is not usually present in hyperesthetic rhinitis.

Having referred to the important points of contact between hyperesthetic rhinitis and myxedema, or the hypothyroid syndrome, I wish to allude briefly to some other opinions which

connect the nasal condition with endocrine dysfunction. Senseny,¹⁶ speaking of the relation of endocrine changes to nasal neuroses, rather connects the symptoms of hyperesthetic rhinitis with pituitary insufficiency. Mithoefer,¹⁷ in studying a patient with constant infiltration of the nasal mucosa, found symptoms of mild hypothyroidism, and Beck¹⁸ claims that hyperplastic ethmoiditis is due to hyposecretion or dysharmony of one or more of the ductless glands; and¹⁹ that the pathologic changes found in the middle turbinates and curretted portions of the ethmoid in asthma and in nonsuppurative sinusitis are very striking, in that the bone shows rarefaction, somewhat resembling that found in early bone changes of osteomalacia, acromegaly and otosclerosis. This pathologic finding is suggestive of a possible etiologic factor in some disturbance of the glands of internal secretion. Kauffman²⁰ also refers to the histologic bone findings in hyperplastic ethmoiditis as being similar to those observed in deficiency diseases, and especially insufficiency of fat soluble vitamin A. Kauffman thinks that the ethmoid bone changes are apparently due to some disturbance in the nutrition of the overlying mucous membrane. Ballenger, in the last edition of his textbook,²¹ says that many of the nonallergic types of vasomotor rhinitis show some endocrine imbalance; faulty metabolism, hypo- and hyperendocrine functioning may be factors in sympathetic reactions, of which vasomotor rhinitis and allergy are possible related expressions. Maybaum²² thinks that the continuous irritation of the mucous membrane in hyperplastic ethmoiditis may be due to a protein sensitization, but that endocrine disturbances are not infrequently associated conditions.

Judging from the facts observed in my own series of cases and from the opinions of others, as expressed in the literature quoted, it is very probable that hyperesthetic rhinitis is a symptom of a localized type of thyroid myxedema in which most of the changes are evident in the nasal mucosa.

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LXXVII.

DIAGNOSTIC MISTAKES: A PLEA FOR THE IMPERATIVE BIOPSY.*

BY M. REESE GUTTMAN, B. S., M. D.,

CHICAGO.

In otolaryngologic practice as well as in other branches of the healing art, the prime desideratum is the cure of disease and alleviation of suffering. That successful therapy is predicated upon accurate diagnosis is conceded by all, and as absolute pathognomic signs and symptoms are few and far between, any means of establishing a definite diagnosis is to be welcomed. Not infrequently the clinical picture together with the physical findings resemble one another in many conditions, and the history at times, instead of clarifying the situation, only increases the diagnostic difficulties encountered, so that even with all the precise laboratory aids at our command it is not unusual to arrive at an erroneous conclusion. Laboratory aids are of course helpful, but one, the biopsy, can be of such certain assistance as to be well nigh infallible. This procedure brings to the surgeon the aid of the pathologist, which usually is only obtained in the deadhouse, when it is valueless to the one most concerned and frequently only of academic interest to the attending physician. Consequently, it is astonishing with what reluctance a good part of a profession views the performance of a biopsy, and the prejudice against this procedure is well nigh universal. This is partly due, no doubt, to a well promulgated belief that the biopsy tends to cause more rapid metastases of malignant neoplasms, and also to the dictum that it is a lazy man's method of diagnosis and tends to minimize accurate clinical observation.

In our specialty the clinical distinction between the causes of chronic ulceration, tumefaction and lymphadenopathy is many times not only very difficult but frequently improbable or even impossible without the aid of a microscopic section.

*From the Clinic of Drs. Joseph C. Beck and Harry L. Pollock.

Especially in those vital instances where the therapeutic approach is a major surgical procedure, or where a prognosis of an early exitus with its consequent mental upset is at stake, an absolute and, as far as possible, impregnable diagnosis must be established. We have met with a number of cases where the biopsy has so upset our clinical diagnosis as to engender radical change in either the prognosis or the therapy to such an extent that in consequence we have had to formulate the following rule:

No matter how typical the clinical picture may be, a biopsy is imperative whenever malignancy is diagnosed, suspected or even considered, providing, however, that the lesion is surgically accessible and the condition of the patient such that the procedure may be carried out with safety. Furthermore, in view of the fact that trauma, surgical or otherwise, has a distinct influence on the rate of growth and tendency to metastasize of a malignant neoplasm, and that the only successful treatment to date is early and radical removal, we have made it a condition that immediate surgical intervention be permitted in event that a malignancy is found at biopsy. That this rule may, at first glance, appear somewhat radical is granted, but a perusal of the following case reports will show the basis for this stand:

Case 1.—J. S., male, age 68, junk dealer by occupation, referred to the clinic on account of hoarseness, which came on following a cold six months previous. Gave a history of cough and expectoration for the past year. Laryngeal examination disclosed a "rat bitten" appearance of the left cord with fixation and swelling of the arytenoids. Although physical examination, fluoroscopy of the chest and sputum examination were all negative, a tentative diagnosis of suspected tuberculosis of the larynx was made. The provocative Wassermann was also negative. In view of the lack of sputum and chest findings a biopsy was urged. The tissue was removed by means of a Haslinger laryngoscope and was returned as "squamous cell carcinoma."

Here we have a patient with a laryngeal picture so typical of tuberculosis that it could be used for teaching purposes, which on biopsy proved to be malignant.

Case 2.—S. R., male, age 58, butcher by occupation, referred to the clinic on account of hoarseness that has persisted for the past eight months. The laryngeal examination disclosed a right side growth the size of a cherry pit, firm in appearance and somewhat whitish in color. No glands were palpable. Physical examination, except for hypertension and arteriosclerosis, was negative. Provocative Wassermann, sputum and chest X-ray were also negative. The age of the patient, together with the appearance of the lesion, indicated a diagnosis of carcinoma, and a biopsy was performed. Tissue report was "fibropapilloma."

In this instance the lesion was so typically malignant that laryngectomy was suggested, providing, however, that the biopsy sustained the clinical diagnosis. Recently there has come to our notice a case where a laryngectomy for carcinoma was performed by an able laryngologist, which upon examination by the pathologist after removal was found to be tuberculosis. Such costly mistakes are regrettable and could easily be avoided by insistence of biopsy.

Case 3.—Dr. C. I., male, age 32, dentist, consulted for treatment of a nasal sarcoma. Diagnosis had been made by a local rhinologist, who had removed a number of polypi from his nose several years before. As he had a return of his symptoms of nasal obstruction and impaired smell, he returned to this same physician, who removed a mass the size of a small pigeon's egg and told him it was a round cell sarcoma. The man's mental state may easily be imagined. Examination disclosed a number of small polypi in the nose, which were removed, and the pathologist's report was "myxofibroma." He returned with a microscopic section from which the preceding physician had made his diagnosis of malignancy, and this also showed a benign myxomatous growth.

In this case the diagnosis of malignancy with its consequent mental anguish could have easily been averted by proper microscopic examination of the excised tissue.

Case 4.—Mrs. H. J., female, age 42, wife of a physician, referred to the clinic for treatment of a carcinoma of the larynx, the diagnosis being made elsewhere. She had been hoarse for several years and otherwise her history was nega-

tive. Laryngeal examination showed a small nodule the size of a split pea in the center of the right cord, of a whitish appearance and somewhat firm in consistency. The rest of the examination, chest, sputum and provocative Wassermann, were all negative. The growth was removed with a punch under the Haslinger laryngoscope, and the pathologic report was "fibroma."

This is another instance of a terror stricken patient, whose mental state and home life were all upset by a diagnosis easily shown to be erroneous by biopsy.

Case 5.—R. B., male, age 14, student, referred to the clinic on account of a nasopharyngeal growth. He had complained of nasal blockage, partial on the right, complete on the left, associated with a nasal discharge and inability to keep his mouth closed. He had a definite rhinolalia clausa, and examination disclosed the soft palate bulged forward by a mass, round in character, the size of a pigeon's egg, somewhat firm in consistency and having a diffuse attachment to the vault of the pharynx. The Wassermann and general examination and the history were negative. Nasopharyngeal fibroma, fibrosarcoma and fibrous polypi were considered in the diagnosis. The lack of polypi in the nose, the character and rapid enlargement of the growth allowed us to tentatively concur with the referring physician's diagnosis of sarcoma. However, biopsy, secured under considerable difficulty due to profuse hemorrhage, showed the growth to be a fibroma.

A biopsy cannot be easily secured in every case. Not infrequently some systemic condition may prevent one from obtaining a bit of tissue, as is shown by the following:

Case 6.—N. G., male, age 62, storekeeper by occupation, complained of hoarseness, dyspnea on exertion and attacks of precordial distress. He could speak only in a whisper, and examination disclosed a myocarditis with an auricular fibrillation. Laryngeal examination showed a neoplasm the size of a cherry in the right ventricle. He was hospitalized, and after two weeks the internist reported that his condition was satisfactory for laryngeal suspension and biopsy. However, any attempt to pass the instrument brought on an attack of dyspnea and cyanosis, which necessitated discontinuance of the procedure.

One must ever bear in mind Osler's dictum that no diagnostic measure should ever be instituted which is more dangerous than the condition that is under observation.

Case 7.—J. G., male, 22, law student, referred to the clinic complaining of pain and tingling sensation down the right arm associated with a large mass on the right side of the neck. He had been told by his physician that his condition was a glandular enlargement due to chronic infection and would subside following a few X-ray treatments. Examination disclosed a firm mass, the size of an orange, just above the right clavicle and extending to the hyoid bone. It was not movable, although the skin above it was free. The blood examination, Wassermann and physical, were all negative. A tentative diagnosis of Hodgkin's disease was made and biopsy performed. The tissue report was "lymphosarcoma." The patient expired three months later.

Case 8.—Dr. H. P., male, age 52, complained of soreness of the right side of his throat. Examination showed a ragged ulcer, the size of a quarter, on the right tonsil extending over to the anterior pillar, the edges being indurated. The history, together with the physical examination, disclosed nothing more important. The Wassermann, chest fluoroscopy and sputum examinations were also negative. The referring physician had found a few Vincent's spirilla and fusiform bacilli in the smear from the ulcer, and had treated it as a specific angina with local and intravenous arsphenamines, with but little success. A small piece of tissue from the edge of the ulcer was returned with a microscopic diagnosis of "carcinoma."

CONCLUSIONS.

1. The history, physical examination and ordinary laboratory aids not rarely are insufficient to establish a correct diagnosis.
2. Biopsy, when properly performed, is a most precise and infallible diagnostic procedure and can be relied upon to establish a pathologic basis for an exact clinical diagnosis.
3. A good portion of the profession which would unhesitatingly perform a thoracocentesis or spinal puncture views the biopsy with something akin to apprehension.

4. A biopsy is imperative in all cases where clinical distinction between several conditions is difficult, when an unfavorable prognosis or a major procedure is at stake, and especially whenever malignancy is diagnosed, considered or even suspected, providing, however, that the lesion is surgically accessible and there are no systemic or local contraindications.

5. As a condition of the performance of a biopsy insistence should be made that immediate surgical intervention be permitted in event of the return of a malignant diagnosis by microscopy.

2551 NORTH CLARK STREET.

SOCIETY PROCEEDINGS.

TRANSACTIONS OF THE MIDWINTER MEETING
OF THE MIDDLE SECTION OF THE AMERICAN
LARYNGOLOGICAL, RHINOLOGICAL AND
OTOLOGICAL SOCIETY, HELD IN ST.
LOUIS, JANUARY 31, 1927.

Demonstration at Central Institute for the Deaf.

This demonstration consisted of a practical demonstration by the teachers and pupils of some of the unusual phases of the work in which this Institute is engaged, under the direction of Dr. Max A. Goldstein and members of the faculty.

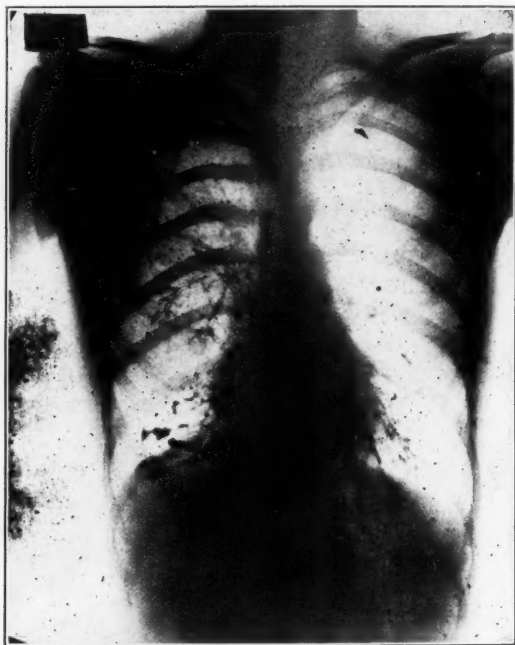
**A Simple Method of Introducing Lipiodol Into the Lungs, With
Exhibition of Plates.**

BY J. J. SINGER, M. D.,
ST. LOUIS.

In presenting this method to this association, I feel somewhat hesitant, because I have been more or less criticized in some places because I assumed, or presumed to be able to put oil in the lungs without any instruments other than a syringe.

Bronchoscopy was the method originally used and also the tracheal cannula put in between the cords. Another method was to cocaine the muscles of the throat and neck, and introduce a small curved needle through the trachea, and introduce the oil in that way. In 1922, shortly after the discovery of lipiodol, a Frenchman named Lian suggested that it could be introduced by pulling out the tongue and letting the patient aspirate it. I read French very poorly and thought that he was successful. My associate later read the article and found that he was really unsuccessful. If I had known French I would never have attempted the method. We have used the method since April and have been successful in 80 per cent of the cases. Any patient who will tolerate the instrument, a tongue depressor, without gagging, will take this instillation very easily. This patient has bronchiectasis. You will be shown a plate which we took of this girl a few minutes ago.

You will see that the right side has a little thickening in the lower right lung. The opposite lung is relatively clear. I have a picture, taken several months ago, with the oil injected according to the method I am about to use. You will see the bronchial dilatations, fluid levels and normal bronchus. You



Patient has bronchiectasis. Plate shows the right side has a little thickening in the lower right lung. The opposite lung is relatively clear.

will see that we put the oil where we want it. The objection has been that you cannot localize it. We are able to direct the oil by its own weight to the lower lobe. You can direct this oil as you would any other liquid by the position of the patient. The secret of lipiodol injection and the art of getting it in is

very simple. The oil must be so warm that it flows easily.

This patient has been given this treatment for four or five months as a treatment for bronchiectasis which is not suitable for operation. Twenty per cent do not take it nicely. In those, we put cocain in the pharynx and a little into the trachea, and



Photograph shows introduction of 20 cc. of iodized oil in both lungs, bilateral bronchiectasis. The simple method of introducing iodized oil was used.

are able to do it almost invariably without a tracheal tube or bronchoscopy.

By holding the tongue out as far as possible and dropping in the oil back of the tongue, the oil, of its own weight, will drop into the position that the bronchial tubes are directed. I will let the patient lie on either side, just to demonstrate that it can be done.

Now I would like to show plates taken of other patients and conditions.

This X-ray work has been accomplished through the co-operation of Dr. Moore, in such a way that we are able almost

every time to make a diagnosis. We combine this with the physical findings and the X-ray.

This second patient came from Denver with a history of bringing up large amounts of sputum. The plate looks relatively clear. Dr. Moore will discuss the plate. I will show a plate before and after lipiodol.

DISCUSSION.

DR. MOORE: The plate shows an increase in calcified glands in the field of the descending bronchial branches. To go back before the injection, and from an X-ray standpoint alone, I do not believe any radiologist would be warranted in drawing any conclusions from it; and yet the patient is extremely sick—chronically ill. There is no question about that. With this method of contrast we get precisely and accurately at the source of the trouble in a field where the X-ray had gone as far as it could and is a failure in arriving at what the diagnosis is. This patient had been bringing up half a cupful of foul pus two times a day. The patient was given pneumothorax and is very much improved.

DR. SINGER: Here is another condition that would defy anybody anywhere in the diagnosis of the shadow without interpreting it in the light of lipiodol.

DR. MOORE: As far as radiology could go in this case, I could note that there was an almost complete opacity of the right lung field, which may be the result of a tumor of the mediastinum or any collection of fluid in the pleural cavity. Furthermore, I realize it would be extremely difficult, on physical signs, to get at a true conclusion as to what that shows. The idea of looking at an aneurysm with a fluoroscope is pathognomonic. It is a rare case where they can be found. The first case leaves you in great doubt as to what it possibly could be.

Third Plate.—This is a case that Dr. Proetz bronchoscoped a few days ago. This girl, for the last fifteen years, had been bringing up from one-half to two and three cupfuls of foul sputum a day. When she was four years old a collar button was found in her nose. It was thought that possibly she might have aspirated one of these buttons, which she had been playing with, into the bronchi. She was given lipiodol in Chicago,

where she lives. You will note that the right lung shows the presence of lipiodol. We attempted to map out the left lung to see if the findings were the same on the left side, but found it was not involved. Through the bronchoscope, Dr. Proetz was unable to fill the left lung with lipiodol. We assumed from a study of the plates, using lipiodol, that there was a constriction in the lower left lobe. Pneumothorax would be contraindicated and treatment might be accomplished by bronchoscopy. I am sure that the plates alone or the bronchoscopy alone would not have given us this information.

Fourth Plate.—This is a case of tuberculosis who had been undergoing pneumothorax treatments. Nothing that I know of, no signs that I know of, could possibly give us the picture that we have with lipiodol.

DR. MOORE: We see here that the upper and middle portion of that lung is probably more or less homogenous. The generalized occlusion of the tubes would indicate a pneumonic state in that lung. The first value of lipiodol is in the fact that it gives us information about the tubes with alterations in caliber and their location.

Displacement Irrigation of the Paranasal Sinuses.

BY ARTHUR W. PROETZ, M. D.,
ST. LOUIS.

I should like to show, very briefly, a simple method for putting solutions of any kind into the paranasal sinuses. The best way is to put the patient in the supine position, so that the head hangs over the end of the table; the tip of the chin should be above the external auditory meatus. The solution is then run into the nose with a syringe or medicine dropper, and it lies on the face of the sphenoid. It does not enter the sinus at this point. Very gentle intermittent suction is then applied to the nostril, which draws the air out of the sinus, a bubble or two at a time, and the air is replaced by the overlying fluid. When the patient returns to the upright position, the fluid remains in the sinuses from two hours to five days. Since this method was published, I have worked out an additional position. The patient is put in the prone position and the head extended over the table. One nostril is filled with solution. Suction is then applied to the other nostril. The nose can be

filled to a point where every ostium will be covered by solution before it runs into the other side.

Demonstration: Normal salt solution with ephedrin, $2\frac{1}{2}$ cc., placed in each nostril and intermittent suction applied; patient in supine position.

(Then followed a series of 24 slides, illustrating method, also several sketches.)

Bilateral Mastoid Operation.

By BERNARD McMAHON, M. D., AND L. F. FREIMUTH, M. D.,
ST. LOUIS.

DISCUSSION.

DR. ALEXIS F. HARTMANN, St. Louis: This infant does not represent the acute or severe type of infection, and we felt that it would get along well without operation, using good feeding, transfusions, etc., and, in fact, the infant did gradually improve. There occurred, however, a time when the temperature became more elevated, and at about that same time vomiting again became marked and the stools were numerous. He also developed pus in the urine. We feel now that the infant should be operated upon, that it would be very much benefited by postauricular drainage.

DR. H. W. LYMAN, St. Louis: We thought it might be interesting to demonstrate the technic of this operation, as performed in the St. Louis Children's Hospital. Two years ago Dr. Alden and myself reported fifteen cases which had been operated upon with eight recoveries and seven deaths. We feel that a great many infants succumbed formerly because we operated too late. Our present procedure is to operate much earlier. Our technic has become somewhat simplified, and we feel that the operation itself does not imperil the patient's life nearly as much as the condition for which we operate. We use 5 per cent picric acid in alcohol for skin preparation. About half an hour previous to the operation, if there are no contraindications, a preliminary dose of codein or morphin is given, varying in size with the age of the child. The field is surrounded by towels, and $\frac{1}{2}$ per cent novocain with eight to ten drops of adrenalin to the ounce is used as a local anesthetic. After the skin behind the auricle is infiltrated, a deep injection is made in an attempt to get under the periosteum in the region of the antrum. The usual incision for an infantile mastoid operation is made, starting opposite the middle of the external

auditory meatus and extending upward about $\frac{3}{4}$ of an inch. The periosteum anterior to the incision is then elevated. For a periosteal elevator we find that Freer's sharp septal elevator is the most satisfactory instrument. We also use Brophy's elevators. The anterior structures, including the periosteum, are retracted and the bony canal is exposed. For this purpose we use Cushing's vein retractors, one with saw teeth and one without. One retractor is all that is usually necessary. This exposes the area over the antrum. The perforated area over the antrum is usually easily recognized. Where these foramina are not seen, we simply take off the cortex in the triangle between the posterior curve of the auditory canal and imaginary lines drawn backward from the top of the canal and vertically from the posterior border of the canal. For this purpose we use a hand gouge so that the cortex can be removed without concussion and without the point of the instrument injuring the intracranial structures. We use a 7 mm. gouge, designed by Dr. Green of Boston, and a 5 mm. gouge of Dr. Randall of Philadelphia. These were originally designed for adult mastoids, but we find them very satisfactory for opening these infantile mastoids. An Alexander gouge can be used for the same purpose. This quite frequently uncaps the antrum, and pus can be seen in the cavity. If not, a few more shavings removed with the gouge exposes the antrum. A culture is then taken from the antrum. This is given to Dr. Spahr, who is doing the bacteriologic investigations in these cases. The contents of the antrum are then removed with a small oval curette. Any small spoon curette will answer the purpose. We do not do much curetting, but do remove any necrotic bone. There is a question in the pediatricians' minds as to whether we should curette out the antrum and remove the debris. They question whether the curetting does not make convalescence a little more stormy. This may be true, but we feel, from the otologic point of view, that what we are trying to establish is drainage from the antrum and aditus, and that this can best be accomplished by the removal of the contents of the antrum. We do not curette the bone any more than we feel obliged to at the time of operation. After the antrum is cleaned out and probe introduced into the aditus, a rubber or gauze drain is placed in the antrum and a pad of gauze placed over

the wound; no suturing is done. A temporary dressing is placed over the wound, and held in place by a strip of adhesive. A sterile towel is placed under the head, and the same procedure is carried out on the opposite side. Drs. McMahon and Freimuth will now operate upon the other side.

Question: What is the mortality from this operation?

DR. LYMAN: We do not believe that the operation in itself has caused the death of any of these babies. Since October 23rd we have operated upon thirty-four cases, with six deaths. Two of these were due to conditions having no relation whatever to the mastoid. In four of the cases the operation was not succeeded by an amelioration of the condition, and the cases went on to a fatal termination. We feel that the decreased mortality in this series is due chiefly to the fact that we operate much earlier.

Question: How long does the antrum drainage keep up?

DR. LYMAN: This varies greatly. We endeavor to keep the antrum open until there is no discharge through the ear canal, because we feel that if the mastoid wound is allowed to close while there is still infection in the middle ear, we may have the same condition for which we originally operated. Some cases heal promptly in two or three weeks. Other cases go along for many weeks before even an attempt at repair can be seen. This is especially true of the pneumococcus infections. The colon bacillus cases have also been very slow in healing, while, strange to say, the hemolytic streptococcus cases have healed in less time.

**Chemical Changes in the Body Occurring as the Result of Infection,
Particularly in the Nose and Throat.**

BY ALEXIS F. HARTMANN, M. D.,

With the aid of lantern slides, the chemical changes in the body occurring as a result of infection in the upper respiratory tract, including the paranasal sinuses and mastoids, were discussed. Only two types of cases were included in the discussion: (1) The type of infant who showed as symptoms of infection, vomiting, diarrhea, fever and the consequent loss of water from the body by way of the intestinal tract, which is sometimes designated as hydrolability. (2) The second type of case was that of nephritis, which included both of the most

common types—that is, acute hemorrhagic nephritis and the parenchymatous type.

In general, the discussion brought out first the changes in the blood occurring as the result of vomiting, which were, in brief, a decrease in the chlorid content of the blood, an increase in the bicarbonate content of the blood with consequent alkalosis, and usually a small but significant decrease in the total electrolyte content of the blood. The frequent increase of nonprotein nitrogen content of the blood was encountered, and its possible significance in compensating for the loss of electrolyte from the blood and maintaining normal osmotic pressure of the blood was touched upon. The disastrous effects of long continued administration of normal saline solution, as a means of administering water to cases in which vomiting and diarrhea are severe, in creating hydrochloric acid acidosis, were brought out. The effect of diarrhea, with its consequent salt and water loss, was also discussed. The effect of fever, particularly on the $\text{H}_2\text{CO}_3/\text{NaHCO}_3$ ratio, was mentioned. The strong contraindication to the administration of sodium bicarbonate in such cases as these was stressed.

In general, it was apparent that the chemical changes found in the blood were very definitely associated with infection and in part could be accounted for by the principal symptoms of vomiting, diarrhea and fever. It was apparent, however, that other symptoms must necessarily play a part, such factors as change in the surface tension, permeability of membranes, and in the hydrophilic property of colloids, which were mentioned briefly and pointed to as probable important factors requiring close study.

Demonstration of Charts of Infantile Mastoid Cases.

By A. M. ALDEN, M. D.,
ST. LOUIS.

Some typical cases of infant mastoiditis with marked gastrointestinal findings were demonstrated by a series of lantern slides.

Bacteriologic Data.

By MARY SPAHR, M. D.,
ST. LOUIS.

For the past three months mastoid and middle ear disease in infants has been studied bacteriologically in an effort to

correlate the clinical symptoms and course of the disease with the organisms found on culture. In this time but thirty-two cases have undergone mastoid operation. Considering, further, that eighteen of these cases are still in the hospital, not only are conclusions impossible, but the data is fragmentary.

All material has been cultured on blood agar. The swabs from the mastoids are streaked directly on the blood plates. In culturing infections of the middle ear, great care is taken to avoid contamination by organisms in the external auditory canal. The culture is made by streaking the knife, immediately after paracentesis, upon a blood agar slant, or wiping the knife with a sterile swab wet with broth and using this swab to inoculate the plate.

In all, cultures have been made from 99 middle ears, representing 60 cases, and from 59 mastoids, representing 32 cases. In 22 instances, after an early culture has been made, the corresponding mastoid has been opened and cultured. It is disappointing to note that only seven times has an organism recovered from the ear been found also in the mastoid.

Before going further, perhaps I had better list the organisms found in the mastoid and middle ear:

MASTOIDS.

Name	Number	Cases	In Pure Culture
Hemolytic streptococcus....	22	13	21
Pneumococcus.....	12	8	9
Staphylococcus.....	10	7	5
Diphtheroid.....	9	7	1
Bacillus coli.....	4	3	3
Bacillus of Morgan.....	2	1	2
Micrococcus catarrhalis.....	1	1	
No growth.....	3	2	

Of these three sterile cultures, two were from the two sides of one case of double mastoid disease. The third, from another case of mastoid disease, showed on culture later a pneumococcus on the other side.

In 49, or about 85 per cent of these cases, one organism was found in pure culture. In the seven mixed cultures, a diph-

theroid was found as a second organism at times, and micrococcus catarrhalis once.

In the ear, the emphasis is changed.

	Ear	Pure
Staphylococcus	81	29
Diphtheroid	31	4
Hemolytic streptococcus	11	5
Trichomycetes	10	0
B. coli.....	7	1
Pyocyaneus	5	2
Streptococcus viridans.....	5	1
Nonhemolytic streptococcus.....	2	
B. of subtilis group.....		
Micrococcus catarrhalis.....	1	
Bacillus influenzae.....		
No growth.....	2	

In only 43, or less than half of these cultures, was one organism found in pure culture, suggesting contaminants so frequently present that the infecting organisms may be overgrown.

Five cases showed the usual mastoid signs. Of these cases with subperiosteal abscess, four showed a hemolytic streptococcus, one a pneumococcus.

In sixteen cases showing well marked diarrhea, pneumococcus was found six times, bacillus coli three times, the bacillus of Morgan (an intestinal organism) once, and the streptococcus hemolyticus four times. To put the figures differently, four or all the cases with intestinal organisms cultured from the mastoids had diarrhea. Six, or three-fourths of the eight cases with pneumococci had diarrhea, while only four of the thirteen cases with hemolytic streptococcus had diarrheal symptoms.

In the seven cases with vomiting, six different organisms appear; only one organism, a staphylococcus albus, appears in two cases.

Of the six deaths in cases with mastoidectomy, one case had a staphylococcus albus grown from the mastoid, one case bacillus coli on one side, pneumococcus on the other; one case showed pneumococci in pure culture; one bacillus of Morgan;

one case was incompletely cultured. The only fatal case showing hemolytic streptococcus on culture died twenty-seven days after operation of a cause unconnected with the mastoid.

While, of course, the figures are too small, and the information too scattered for any generalizations, still it is interesting to note that while the dreaded hemolytic streptococcus was found in 40 per cent of the cases of mastoidectomy, in none of these cases was there a death due or secondary to mastoid disease.

And it seems significant that, when the indications for operation were in the vast majority of cases the general condition of the child, rather than local signs of the mastoid, only three of the fifty-nine mastoid operations gave sterile cultures, and but one case had sterile culture from both mastoids.

Pathologic Discussion.

BY B. J. McMAHON, M. D.,
ST. LOUIS.

In discussing the microscopic pathologic findings which I have encountered in the tissue removed from these infant mastoids, it would be premature to draw any definite conclusions from our observations so far. All the tissue removed is preserved in formalin, decalcified, stained with hematoxylin and eosin, and examined thoroughly. I shall but mention a few of the salient changes encountered:

Bone: Varied from the normal cartilaginous to fully established young bone. It was found to be necrotic in the central portions or resorbed along the peripheral margins or sclerotic. Other areas showed infiltrations with polymorphonuclear leucocytes and all the forms of connective tissue cells. The osteoclasts and pure osteoblasts were conspicuous by their absence. The interspaces were filled with either normal areolar tissue containing the lamellar, plasma and older connective tissue cells, or polymorphonuclear leucocytes.

Periosteum: Showed a fibrous thickening of various degrees in certain places, while in others it was unchanged in the same specimens, and yet in other places there would be a marked infiltration with red blood cells or polymorphonuclear leucocytes.

Mucosa: In practically all the slides examined, this showed more or less edema and infiltration with polymorphonuclear leucocytes or older connective tissue cells. In a certain number of cases there was much free blood present also. I am looking forward to finishing up this work entirely by the end of the year, hoping to be able to establish some significant relationship between the symptoms, both local and constitutional, and the gross and microscopic pathology, so that we may be able to be guided in our prognosis by this actual pathology found.

Presentation of Two Unusual Cases.

By H. W. LYMAN, M. D.,

ST. LOUIS.

M. J. H., aged three years. Child admitted November 12, 1926, with left otitis media, left mastoiditis and paralysis of the left external rectus (Gradenigo's syndrome).

The otitis media began one month previously, and the paralysis of the external rectus one week previous to admission.

On the 14th the mastoid was opened and found to be of pneumatic type. Mucopus was found in the antrum.

The postoperative course was uneventful until the 18th, when the temperature rose to 40.5° . There was projectile vomiting, reflexes on the right side were hyperactive, the child was drowsy, neck somewhat rigid, discs normal. A lumbar puncture was done and spinal fluid normal. Spinal manometer readings showed an obstruction of the sinus on the left side. The left internal jugular was tied and the sinus opened. Free bleeding occurred. The sinus was packed. The vessels in the dura of the temporal lobe appeared somewhat congested.

Patient did very well after his operation, but we were greatly disturbed by a report from the laboratory of a positive culture from the spinal fluid of bacillus influenzae. No smear, however, was made. On November 28th the temperature again rose to 40.3° . This was due to an acute infection of the right ear, and the leucocyte count went to 27,100. No definite cause was found for this, and the temperature subsided to normal in two days.

On December 24th, the temperature again rose to 40.2° and continued to fluctuate until after the right mastoid had been opened on December 28th, since which time the child has developed no new or alarming symptoms.

M. K., aged twenty months, admitted March 10, 1926, with a complaint of cold, swollen cervical glands and hemorrhages from the nose and throat. Illness began March 1st with high fever and cervical adenitis.

On the 7th the child had a severe spontaneous hemorrhage from the throat. On the 8th the throat was lanced by a doctor for quinsy. On the 8th and 9th the child had hemorrhages, and on the 10th—the day of admission—a very severe hemorrhage.

On entrance the child was comatose and exsanguinated, with clotted blood coming from the nose and mouth, left pupil smaller than the right. An emergency transfusion was given. A bulging mass on the posterior pharyngeal wall was opened. It was impossible to determine whether fresh pus was obtained or not.

The child's red count was 2,225,000 with 95,000 leucocytes. Temperature 39°. Culture from the retropharyngeal cavity gave hemolytic streptococci. On the 12th, blood culture was reported positive, short chain streptococcus hemolyticus. On the 13th, left ear discharging profusely, condition of the throat having improved.

On the 14th, spinal manometer tests were made and showed evidence of obstruction of the left lateral sinus. The left jugular was exposed and found filled with a white organized clot. The jugular was ligated, opposite the sternoclavicular joint, and the incision closed. The mastoid was then opened and found to be of the pneumatic type with a very large tip cell containing pus and granulation tissue. After the cells were removed the necrotic bone over the lateral sinus was taken away, the sinus was found thrombosed, the clot was removed, free bleeding obtained from behind, the wound packed tightly with gauze, and pressure bandage applied. The child made a slow recovery, the paralysis persisting until April 20th, before she was able to use her hand. There is still a very slight drag in the right foot.

Skin Grafting in Tracheal and Laryngeal Stenosis.

BY M. F. ARBUCKLE, M. D.,
ST. LOUIS.

I desire to report three cases of laryngeal stenosis in which attempts at treatment by the ordinary endoscopic methods were unsuccessful. It was possible, however, to reestablish the lumen by an external operation in which the larynx was opened, the adhesions freed by dissection, the collapsed wall replaced in normal position and Thiersch skin grafts applied to prevent contraction.

In cases one and two, the skin graft was mounted on a rubber balloon. In case three, a sea sponge was used to support the graft. Although the sea sponge is rather slippery, it has the following advantages over the balloon: (1) It is difficult to work with a balloon without puncturing it; (2) it is difficult to maintain adequate air pressure for the time required before the balloon can be removed; (3) the balloons are difficult to obtain and the rubber deteriorates.

In the application of Thiersch grafts, careful application of pressure is considered imperative. G. W. Crile reports a case of laryngeal stenosis in which the larynx was opened wide, the scar tissue completely dissected out and an attempt made to cover the raw area immediately with large and accurately placed skin grafts. The grafts in this case did not grow, and it is my feeling that the failure was possibly due to his having neglected to apply pressure to the grafts.

Herr Z. Lenart of Budapest also saw a case in which adhesions followed three weeks after surgical removal of tubercular granulations. The patient was treated by laryngofissure and excision and the application of Thiersch grafts.

Cases 1 and 2 were diphtheria carriers, cultures from the tracheotomy tube being repeatedly positive for diphtheria bacilli, though cultures from the throat were negative. This infection cleared up promptly after operation.

With cases 2 and 3, it is felt that sufficient time had elapsed since the operation to justify the belief that relief is permanent. With Case 1, the results were equally satisfactory, so far as reestablishment of the laryngeal lumen was concerned, up to the time of the patient's death.

It will be noted in each of these cases that an emergency tracheotomy was done only after repeated difficult intubations and final failure to reintubate. It is our feeling that much of the destruction of tissue and subsequent stenosis could have been avoided had these patients been tracheotomized early and the larynx put at rest.

CONCLUSIONS.

One hesitates to report a series of only three cases. In this instance, however, a well established surgical principle is merely employed in a new field, and it seems fair to conclude from the results obtained that this method may be used successfully in treating laryngeal stenosis of the type described.

The two definite advantages would seem to be apparent: (1) That the length of time required for treatment and convalescence is much shortened; (2) that the method is applicable in cases which cannot be treated by endoscopic methods.

Exhibit of Plastic Surgery.

By V. P. BLAIR, M. D.,
ST. LOUIS.

I would like to bring your attention to some points in regard to the casts. The main point is to bring forward the tip of the nose, lip or the tissues around the anterior opening of the nose. The general plan used was first to free the soft tissues, the upper lip, cheeks, columella and skin or the tip and dorsum from the supporting tissues, the maxilla, septum and nasal bones, and then suture the former in an advanced position on the latter. To do this, the mucous lining of the nose is incised along the floor and septum but not in the vault of the vestibule.

Paper: "Ophthalmic Contacts With Otolaryngology."*

By W. H. LUEDDE, M. D.,
ST. LOUIS.

DISCUSSION.

DR. W. E. SHAHAN: It has been a pleasure to listen to this paper of Dr. Luedde. It is a clear and constructive exposition

*See page 786.

of the situation as it confronts us at the present time. It is probable that ophthalmologists were first to recognize and have forcibly impressed upon them an intimate relationship between certain very grave eye diseases and certain nasal conditions, which in themselves are often of no great importance.

The first real textbook on ophthalmology was written by a Scotchman by the name of Mackenzie, some seventy-five years ago. In this he stated clearly how amaurosis, or blindness, may be caused by disease occurring in the accessory nasal cavities, and particularly notes that a sudden cessation of nasal discharge may be a serious danger signal as indicating a blocking of sinuses with involvement of one or both optic nerves.

Since the days of Mackenzie, great progress has been made in all branches of medical science, and the field of ophthalmology alone has become so broad that no one mind is capable of covering it all. Accordingly, many of us have abandoned all pretense to skill or competence in handling nasal conditions and are utterly dependent upon the rhinologists for success in solving some of our most serious problems. I have seen a few spectacular recoveries of vision following sphenoid operations where it was necessary to crowd the rhinologist to get the operation done. And yet, I am aware that this is a dangerous procedure. I have seen a patient leave the hospital for the cemetery following this operation. But when a patient is steadily losing his vision we are willing to take almost any risk to stop it, feeling that almost always a dead man is better off than a blind one.

Knowing the importance of this, however, it is necessary for us to keep our feet on the ground, to use judgment, and not expose our patients to needless mutilation or suffering. I was greatly impressed by a paper I heard read some years ago at a meeting of a national medical society, in which the writer, an eye, ear, nose and throat specialist, advocated and stated that he practiced the routine removal of tonsils as a preliminary treatment in all cases of iritis. I have forgotten the writer, but the paper has always been a monument in my mind to enthusiasm without judgment. We are interested in observing progress in rhinology and know that it covers an intricate field requiring great delicacy of touch, careful judgment and fine discrimination, and are glad to note that it is getting away

from some of its old crudities, such as unregulated vacuum pumps, harsh applications, ill advised irrigations and over-enthusiasm for surgical procedures. We feel that our success as ophthalmologists and the confidence of our patients in us is dependent in a measure on the success of the rhinologists and the confidence of their patients and our patients in them and in their work.

Paper: "Pediatric Aspects of Otolaryngology."*

By McKIM MARRIOTT, M. D.,

St. Louis.

DISCUSSION.

DR. E. LEE MYERS, St. Louis: My interest in this subject was first awakened some seventeen or eighteen years ago when we had to fall back on our old friend, "glandular fever." This was before the well applied examination of the nasopharyngoscope. I have followed the work of Dean, Byfield, Jeans and Marriott closely, and considerable credit must be given to them.

Recently a child was brought to me with a pasty complexion, having a definite mastoid infection of the right side, which was proved by the X-ray. After a wide incision of the drum under gas, and waiting a few days, it was decided to X-ray the child. The left antrum was cloudy, and it was then decided to wash out that antrum as a matter of relieving a focus of infection. The next morning the right ear had stopped running, and, peculiar to say, the albumin had left the urine. Several exacerbations of the ear condition occurred synchronously with the child's urine showing albumin.

A second case, a six-year-old child, became chilled while swimming on an extremely hot day in July, two days later complaining of severe pain in the abdomen with vomiting and high fever. She was sent to the hospital expecting a surgical abdomen. Urine examination showed a hemorrhagic nephritis. Consultation pointed to a possible infection from the child's antrums. A recent grippe, from which the child had appar-

*See page 686.

ently recovered had added to it an infection from the water (staphylococci plus streptococci).

Impending uremia controlled by intravenous glucose; transfusions of citrated blood successfully battled the child's impoverished blood condition, the hemoglobin being 60 per cent. Double intrasanal antrum was done for the focus of infection.

Are not some of the cases of poor results from the tonsil and adenoid operations really undiscovered sinus conditions? Zahorsky's critique on this subject was not without avail.

DR. RICHMOND MCKINNEY, Memphis: One point brought out that should be emphasized for its importance is the value of whole blood transfusions in these cases. I think we are inclined to underestimate the value of these transfusions. The one best therapeutic measure of which I have knowledge following mastoid operations in cases where the blood stream infection is pronounced, the temperature running high, and evidence of sepsis marked, is transfusions of whole blood, repeated, as indicated. By this means we build up resistance, wash the infected blood stream, and help to tide the patient over a crisis.

DR. J. J. SHEA, Memphis: Doctors Marriott and Dean have blazed a way in this country in modernizing treatment of children, and I notice the English journals are beginning to recognize their work. It is appreciated that the illnesses of childhood that are not self limited are frequently due to focal infection. We saw this morning a practical demonstration of an operation that was instructive. If ventilation and drainage of the paranasal sinuses will reestablish growth in those arrested by infection during their formative years, it is only natural to assume that simple drainage of the mastoid antrum will serve the same purpose. It will be interesting to observe the future pneumatization in these operative cases.

DR. EDWARD D. KING, Cincinnati: I have had a rather limited amount of experience in this work. We have operated upon five cases in Cincinnati. It would be very nice indeed, if we could formulate the indications for operation on these infants from our own viewpoint, rather than have the pediatrician tell us when to operate. From the small number of cases which we have had, I should say that the simple antrot-

omy is not sufficient. If a mastoid operation is indicated, it seems to me that a mastoid operation should be done in order to get a complete view of the mastoid and to clean out all the cells. The X-ray picture which I have to show is a picture of a child, six weeks old, in which the mastoid process in the right ear was extremely large. One cell was so large and so filled with exudate that we were under the impression at first glance that the child had a sinus thrombosis. In this case the ear signs were almost nil previous to operation, so that it was necessary for us to operate because of the fact that the pediatricians insisted that we open these mastoids. Up to the present time, as far as I can see, the indications for operation are in the hands of the pediatric service.

DR. MARRIOTT (closing): In the treatment of babies with mastoid infections, blood transfusions are of tremendous value. In fact, many of these babies do not recover unless transfusions are given. In most instances we give as many as three or four transfusions and have given more than ten in certain instances. Of almost equal value is the administration of sufficient fluid, and this often has to be given intraperitoneally. Enough fluid must be given to keep a baby's weight from falling off very much. Whenever a drop in weight occurs, that is an indication for injection of fluid. One infant on our service received 76 intraperitoneal injections of saline, amounting to a total of over ten gallons during a period of six weeks.

Undoubtedly a very large proportion of infants with otitis media also have mastoid antrum infections, and certainly many of these clear up without antrotomy. This is especially true in the case of infants previously well nourished. In very small and undernourished infants the infection is less likely to clear up spontaneously, and antrotomy becomes necessary as a life saving measure. Occasionally a mastoid antrum is opened unnecessarily. I recall two instances in which this was the case. In one of these the infant had a double otitis media and constitutional symptoms which led us to advise antrotomy. The antrotomy was done on one side first, and that side was found to be normal. Two days later the other side was opened and found to be full of pus. This was followed by rapid recovery. Another infant in the early stages of pneumonia was subjected to double antrotomy. The antra were both normal. The oper-

ation did the baby no harm and recovery from the pneumonia was uneventful. We have never seen an infant in whom we felt a fatal outcome was to be attributed to the operation. We have, on the other hand, seen a large number in which we were convinced that recovery could not have taken place except for this simple operation.

Paper: "Nasal Manifestations of Allergy."*

BY CHARLES H. EYERMANN, M. D.,
ST. LOUIS.

*See page 808.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY.

Meeting of Monday, January 3, 1927.

THE PRESIDENT, DR. ARTHUR M. CORWIN, IN THE CHAIR.

Wax Moulds of Postnares Openings.

DR. AUSTIN A. HAYDEN made a preliminary report on the use of wax moulds for determining the size and shape of the postnares openings, and presented a patient, a boy, aged 14, who had been operated upon twice for the correction of mouth breathing. The tonsils and adenoids had been removed. The turbinates did not cause obstruction at any point, but there was complete obstruction of the right anterior nasal opening, due to traumatic deflection of the septum, and he had been referred to Dr. Hayden for correction of this defect. Some tonsillar tissue had reformed, and when the patient was anesthetized for its removal it was discovered that he had very small postnasal choanal openings. Dr. Hayden believed that many of these cases are missed during the usual examination made digitally or by mirror. Subsequently he had made casts of these openings, using the ordinary Durch composition of dental wax, which becomes very soft and pliable in water at 140° F., and verified the former findings, for the openings were small pockets, or "bottle-neck" openings. The moulding compound, when removed from water at the above temperature, strangely enough, can readily be held in the mouth without any disagreeable sensation of heat.

The moulds were made by heating the wax and a piece of tongue depressor was cut to form an angle and a string attached to it. Rubber tubes were placed in the nose, and the soft palate was pulled forward. With the mouth gag in place and the tongue held down with one tongue depressor, the wax was placed on another tongue depressor and pushed back into the nasopharynx and held there for two or three minutes. The wax hardens easily, and if not too much is used the moulds can be readily removed.

Moulds from another child of about the same age, and one from an adult showed large posterior choanal openings and large grooves on the sides for the inferior turbinates.

Dr. Hayden believed these moulds would give a relative idea of the size of the interior of the nose and the openings behind and in front.

DISCUSSION.

DR. JOSEPH C. BECK thought the dental compound would be a dangerous material to use, because it becomes brittle and small particles might get into the respiratory tract if the patient was in a sitting position. He assumed that in making such a cast the head would be allowed to hang over the edge of the table so that nothing of this sort could happen.

He recalled similar work that had been done with various materials that had been poured into the postnasal space for the diagnosis of deformities, particularly the work done by Dr. Casselberry many years ago.

DR. GEORGE W. BOOT said that in conversation with Dr. Hayden he had received the impression that Dr. Hayden thought the septum was of uniform thickness, but Dr. Boot had always found it somewhat thicker toward the back.

DR. ALBERT H. ANDREWS said that if one would experiment with dental compound at body temperature, it would be found that it was not brittle until it became cold. By a little experiment one can determine the difference between the air capacity of the anterior and the posterior nares, viz.: dilate the anterior nares, and if the patient breathes better the constriction probably is in front, while if no improvement is noted it is probable that the constriction is farther back.

DR. HOLINGER said there are great variations in the width of the choanæ, and in removing adenoids it is his habit to examine the choanæ very carefully and give the assistants a chance to feel them. In his opinion, narrow choanæ are not the exception but rather the rule. The moulds of Dr. Hayden were instructive in many ways. There is no method that gives as clear an insight into the form of the nasopharynx and the relations of the posterior ethmoid and sphenoid cavities and their openings, to each other, the choanæ and the eustachian tubes,

as do the casts. He hoped that Dr. Hayden would continue this work.

DR. HAYDEN, in closing, confirmed what Dr. Andrews had said about the material not being brittle except when it becomes cold, and this takes several minutes.

Dr. Stein had asked how one could tell that the choanæ were completely filled with the wax, and Dr. Hayden thought there was no way of determining this until the cast was removed.

At first he experienced some difficulty in using the tongue depressor, but he had had a depressor made with a square end, with a small groove undercut in the end so that a small amount of wax could be moulded under this, and it was not necessary to use the string which was formerly employed. He thought it was impossible to make an absolute mould of the choana without encroaching more or less on the nasal passages in front. To him the thing of most importance was that one could by this method prognosticate unfavorably, if necessary, before the operation, instead of having the patients and their families discover afterward that operation had not supplied the full relief sought.

Report on Ephedrin.

DR. GEORGE F. FISKE gave a further report upon ephedrin: At present a number of very able men are engaged in research work upon ephedrin, and we shall doubtless before very long have a fund of knowledge accessible. It is in no sense by way of anticipating that I speak tonight; it is rather to bring forward a few practical suggestions which may help some who are beginning to use this drug.

1. As to the natural and synthetic ephedrin, what I have received from Dr. Read in Peking has been the hydrochlorid of ephedrin, and this has been invariably active, and the different shipments have shown no variation in activity. They have all been natural, derived from the plant *Ephedra vulgaris*. I received a quantity of the synthetic ephedrin chlorid from the other side of the Atlantic. This in my hands and those of three friends was very inactive in comparison with that which came from China. My knowledge of chemistry is too limited to enable me to give a clear reason why the synthetic is not as active as the natural and, of course, it may be that after a

time the synthetic will be just as good and probably much lower in price.

I would like to say that so far as I can judge, the activity of ephedrin hydrochlorid seems to depend upon the fact that it is levorotatory to light. Or, to put it in another way, the Chinese ephedrin is distinctly levorotatory, and the synthetic which I tested was partly levo- and partly dextrorotatory. One chemist tells me that much pains has been taken, without marked success to date, to remove the dextrorotatory quality, and that when that succeeds we shall have our low priced ephedrin. May I say that in my work I have found a similar difference between the natural and synthetic epinephrin.

Although I am a very ordinary mathematician, I will try to give you some idea of the meaning of levorotatory. When a ray of ordinary light or colored light is sent through a rhomboid of Iceland spar—crystallized carbonate of calcium—the ray is split into two parts, two distinct rays, each of which is said to be plane polarized. Send one of these rays through a Nicol's prism of calcium carbonate and then on to another Nicol's prism which is turned at right angles to the first, and the ray is entirely obstructed by the second prism. Now place a plate of quartz between the two Nicol's prisms, and some of the light will go through the quartz and through the second prism, but by turning the prism the light can all be again stopped. This is called circular polarization.

Some organic substances possess the same properties as rock crystal (quartz). For instance, place a tube containing a solution of cane sugar between the two Nicol prisms, and the second prism must be turned to the right to stop all the light. With both ephedrin and epinephrin the prism must be turned to the left. With the ephedrin hydrochlorid I have here the levorotation is 32 degrees.

2. As to solubility, the alkaloid ephedrin (Dr. Read sent me a small amount) is insoluble in water and only slightly soluble in the vegetable oils. On the other hand, both the hydrochlorid and the sulphate of ephedrin are very soluble in water.

3. Although the solutions are as stable as those of atropin or cocain, I would suggest that you obtain the hydrochlorid crystals and make your solutions fresh from time to time instead of using a solution which may be old. In my last report

I spoke of a 2 per cent solution as being the best. I still find it very satisfactory, but several are using a 3 per cent solution. Any strength from 2 per cent to 3 per cent in distilled water will shrink the mucous membrane for intranasal operating, and any ordinary strength of cocain may be used with it.

4. Ephedrin has been used orally quite extensively in treating hay fever and asthma. It has been given in doses of different strength. All that I can say from my own experience is that four adults who took doses of from one-third to one-half grain three times a day reported great heart acceleration and troublesome wakefulness. This might lead us to try doses of one-eighth or one-sixth grain by mouth and then increase if necessary.

5. I have not used it hypodermically. Perhaps one of our colleagues can give us some light.

DISCUSSION.

DR. JOSEPH C. BECK believed that by this time almost everyone had tried ephedrin. Dr. Fiske had supplied him with some that he obtained from China which he had used with great success. In prescribing it patients had great difficulty in obtaining the proper kind, and the 3 per cent solution of the synthetic compound was not satisfactory. Recently they had been able to secure the real article, and the results had been much improved. Dr. Beck had never used it hypodermically, but a number of internists who had used it in asthma had reported negative results.

DR. ROBERT SONNENSCHNEIN said that through the generosity of Dr. Fiske he had used the drug in a limited number of cases and also on himself. It seemed to have an advantage over adrenalin in that very little sneezing followed its use. One disadvantage was that it has a very bitter taste, as have all alkaloids. He believed this could be avoided by using it with applicators instead of a nasal spray, and thus prevent its running down into the pharynx.

He had been told that this drug was used by the Chinese many years before the Christian era. Its use was then discontinued until about the fifteenth century, when it was used, but again allowed to fall into disuse. It was not until the present century that some man in Peking noticed that the drug had a

great pressure raising effect, and thus ephedrin was again brought to the attention of the profession.

DR. AUSTIN A. HAYDEN reported that in talking to an asthmatic patient a short time before, this man told him that his physician in Indianapolis had recommended the use of ephedrin. He used this in a 2 per cent solution, injecting it with the head thrown back with the body in a recumbent position. Dr. Hayden thought the difference between ephedrin and adrenalin was about a ratio of 2 to 8, the patients experiencing relief for eight hours after ephedrin and for only two hours after adrenalin.

DR. OTTO STEIN recommended the use of ephedrin very strongly in the place of adrenalin in almost all cases in which adrenalin is usually employed. He believed it was almost invariably satisfactory for topical applications in the nose. One precaution should be observed: After prescribing it several times, he found that his patients had great difficulty in securing it, and the results were not nearly so satisfactory when they obtained the sulphate, which was the only kind on the market, made by American firms for some time, and one must be sure that the hydrochlorid was being used. It was now possible to secure this, and he was sure the results would be satisfactory.

DR. FISKE, in closing, said that Dr. Read had been very kind in sending him a supply, and as long as he could secure it he would be glad to share it with them. He had been informed that the Abbott Company would have it a little later. The Lilly preparation is in the form of a solution.

Tar Cancer.

DR. GEORGE W. BOOT presented some further details regarding tar cancer.

He stated that the mice which he had presented at the previous meeting had all died, and examination showed that two had developed metastatic cancer in the lungs.

He presented a rabbit that had developed epithelioma on both ears. The peculiarity and importance of the experiment was that the rabbit's ears had been painted twice a week for six weeks about a year ago. For six months there was no apparent change, but within the last few months the rabbit

had developed enormous hyperkeratosis of the epithelium. Sections from the growth had been examined and revealed nests of epithelial cells with marked hornification.

"Cartilage and Bone in Nasal Plastic Surgery."

BY SAMUEL SALINGER, M. D.

ABSTRACT.

The advantages of costal cartilage for restoring the contour of the nose are as follows: (1) It is readily obtainable in sufficient amounts from the right seventh to tenth ribs, without danger of impairing the integrity of the chest wall; (2) it is easily cut and shaped; (3) it possesses remarkable resistance to infection; (4) it may become thoroughly incorporated into the surrounding tissues, retaining its vitality and deriving sustenance from its host.

The disadvantages are: (1) Instead of remaining viable it may become absorbed or replaced by fibrous tissue; (2) the incidental surgery necessary to obtaining the implant implies some slight risk of infection and a scar on the chest.

The advantages of ivory over cartilage are: (1) It is tolerated by the tissues with but very slight reaction; (2) the insertion of the implant is a very simple procedure from the patient's point of view, requiring but very little surgery; (3) the implant is not affected by the host, and chances of extrusion through infection are minimized.

The usual procedure is to cut and shape the ivory to fit a plaster cast or wax model of the patient's nose. It is then polished with sandpaper and perforated with small holes to lighten it and also possibly to serve for the growth of fibrous trabeculae from surrounding tissues. It is inserted through a median columnar incision. There is less danger of extrusion than if the intranasal method is employed, because this usually occurs through pressure on a mucous surface, which is less resistant than skin. Therefore the farther away from the mucous membrane one places the ivory, the less danger of erosion and extrusion. For a depressed tip two pieces of ivory are employed, a columnar prop whose upper end is cut peg shaped to fit into a hole drilled in the lower end of the dorsal piece. They should fit loosely in order to allow for the average mobility about the tip of the nose.

DISCUSSION.

DR. JOSEPH C. BECK congratulated Dr. Salinger on going into the work so earnestly, and hoped he would continue it and not become discouraged, as he would undoubtedly have many applicants for the work. One of the greatest disadvantages of such work was the application of many persons with slight defects who wished to have them corrected for purely cosmetic reasons. He thought it was perfectly legitimate work for professional men to do in order to overcome the work of the incompetent operators. It was very profitable work, but one experienced great difficulty in pleasing the patients and keeping them pleased.

Dr. Beck believed ivory was the most satisfactory material for the implants, although the teaching had been that one should never use a foreign body in the nose, where there was such close proximity to infective organisms. The make up of ivory is such that it is well borne by the tissues, but many of the implants do eventually come out. Celluloid was once thought to be ideal, but finally every implant was extruded. He and Dr. Pollock have done such operations with very satisfactory immediate results, but more than 75 per cent of the implants have extruded in spite of the greatest care. Most of the implants were placed intranasally and not through the columella. He believed this was as good a route as that through the columella, but the transudate of leucocytic substances and serum that will finally form a substance analogous to an abscess eventually forces the implant out in the majority of cases. There might be some personal element that had to be considered in this. For the occasional operator it was more of an operation than it seemed. He had the same trepidation regarding ivory that he formerly had regarding paraffin, although he believed it offered the best results at present.

The shaping of the implant is important, and this can be done well before the operation. He considered Dr. Salinger's method much better than that of Joseph, but thought that cartilage appealed to many individuals in preference to the seeming foreign body. The cartilage is nourished by contiguity of tissue, but when in the loose tissue it is likely to be attacked

by the formation of trabeculae and a certain amount may be absorbed.

Dr. Beck asked why Dr. Salinger had not referred to the use of the X-ray as a control in showing whether or not the cartilage was in place or had become calcified, for the viability or longevity of the cartilage can be demonstrated in this way.

Care is necessary in the question of hemostasis before the implants are placed, because a dry field is necessary. If blood is permitted to remain in the space the implant cannot find a good resting place and failure will result. A transplant can be made over if it is of ivory the same as with cartilage, as they have proved on several occasions. In some cases, where bleeding occurs in spite of great care, it is better to pack with gauze and leave it in until the following day.

He believed that with the work in the hands of such men as Dr. Salinger, it was sure to prove useful. In order to have the patient satisfied with the results of operation, Dr. Beck sends them before operation to someone to have a model made of the face, including the eyes and upper lip, and shows this to the patient before attempting any correction of defects. In case of a slight blemish such a model will often convince patients that the defect is not as great as they had thought and they are satisfied to go without operation, or after operation they have the model for comparison with the results obtained.

In correcting a hump nose one should avoid cutting off too much, for there is always a reaction.

DR. B. F. ANDREWS stated that he had done some of this plastic work. His first patient was a young girl, who consulted him about the time the paraffin injection method came out. He built up the saddle nose by this means and obtained a fairly satisfactory result, but after two years the young lady returned because the paraffin had slipped to one side. He removed it as well as possible, and found a deflection of the septum. He lifted the cartilage and took out the deflection and stuck it back into the cavity made by the cartilage. This grew well and the patient now has a very good nose.

In other cases he had used cartilage from the septum, but prefers to use a portion of the bone from the septum in addition to the cartilage, as he has found that this lasts better and is more satisfactory.

To prepare the patient's mind for operation and to prevent further trouble, Dr. Andrews never tells a patient that he is operating to improve the appearance. If there is some obstruction to breathing or something of that sort, he tells the patient that the operation is done for the relief of that difficulty. If, in addition, the appearance is improved they are pleased.

DR. GEORGE W. BOOT called attention to the importance of getting the transplant underneath the periosteum. He had operated upon one case in which this was not done and the implant was movable. He had to remove it and place it under the periosteum before it would stay in place.

DR. SALINGER, in closing, said in regard to the implantation of septal cartilage that his experience was the same as Dr. Beck's—septal cartilage does not survive. He had tried it in three cases and in each instance extrusion occurred. He agreed that hemostasis was very important, for the cavity into which the implant is placed must be dry. Following any implantation it is necessary to apply some sort of compress in order to keep the implant in contact with the tissues. If this is not done there will be slow bleeding and the formation of a hematoma with infection.

He agreed with Dr. Beck concerning patients who come seeking relief for cosmetic defects. In many instances they are not satisfied with the result. In one case he had to remove the implant twice and reshape it, and still the patient came back to have it changed again.

Another important thing is the prognosis; the slighter the blemish the less satisfactory is the result to the patient. The more noticeable the defect, the better the result from the patient's point of view. He felt that most patients should be discouraged about having slight defects corrected.

Tinnitus Aurium—Some Considerations of Its Causes.*

By T. J. WILLIAMS, M. D.

A large percentage of the cases referred to specialists in otology present tinnitus, either as an isolated symptom or in conjunction with others. Not infrequently do we find exam-

*Abstract of entrance thesis.

ples wherein we can find no lesion in the auditory apparatus capable of explaining the symptoms. Many people grow increasingly deaf for years without realizing the extent of their infirmity, and are finally driven to consult the otologist only by the importunities of friends, but the victim of tinnitus needs no outside urging. He appeals for assistance early because the nature of his malady is such as to make life almost an intolerable burden, and even to render him fearful regarding his sanity.

Tinnitus is not a disease per se, nor is it a definite symptom of some aural conditions which the presence of tinnitus enables us to recognize. Its exact pathology is far from definitely understood. However, we are accustomed to associate all subjective ear sounds with some disordered condition of the eighth nerve.

G. W. McKenzie tells us that theoretically every attack of eighth nerve neuritis should present this symptom, but in practice symptoms often mask it to a considerable extent, and A. W. McKenzie reports two cases where tinnitus continued in spite of complete deafness, until absolute destruction or degeneration of the nerve had taken place. He does not give us any light on whether the relation between tinnitus and eighth nerve neuritis is an organic or a functional lesion. A careful consideration of the subject will, however, force us to the conclusion that many factors enter into the causation of this baffling condition.

Most of our cases of tinnitus can be divided into two general classes: First, those where tinnitus is present without noticeable diminution of hearing, possibly due to disturbance of the function of the auditory nerve centers of the labyrinth, due perhaps to some abnormal state of the circulation. Second, those cases presenting marked deafness caused by a definite pathology in either the external, middle or inner ear.

Dan McKenzie classifies tinnitus as simple or compound, the simple tinnitus being represented by the subjective sound that is uniform in character, however variable it may be in quality or loudness. Compound tinnitus consists of subjective sounds which vary not only in loudness but also in character, several distinct noises being simultaneously audible.

The character of these sounds is variously described by sufferers seeking relief, the patients generally drawing their similitudes from the subjects and noises of their environment. Rural people classify them as the singing of birds, the buzzing of bees or the sound of the wind blowing or rustling through the trees, while urban patients tend to classify their sounds in accordance with their ideas of steam escaping from radiators, the rolling of carriages, hammering and the various noises caused by motors and steam engines.

Dan McKenzie states that compound tinnitus is found in the more serious and obstinate forms of middle ear deafness, often preceding cochlear involvement. He has noted it in otosclerosis and in such general diseases as arteriosclerosis, Bright's disease, high blood pressure, etc.

In everyday practice it is commonly the simple form which we encounter. This form of tinnitus may easily occur in an individual exhibiting no apparent organic diseases. Finding such great difficulty in determining the cause of this annoying symptom through the usual channels of aural investigation, we began to search the literature for analogies involving other sensory nerves that might give us a clue to a better understanding of this condition. To do this required consideration of the physiology and pathology of nerve centers governing other special senses, and seeking what might be an analogous condition associated with the abnormalities of these centers in patients presenting such disorders. We find that exhaustive studies have been carried on to determine alterations which take place in the cortical centers after the enucleation of the eyeballs. We have inquired of some blind patients whether or not they felt that they had any "sense of sight perception" after the eye was removed, as an individual whose legs have been amputated projects a pain or other sensation into his toes. Immediately were we confronted with the problem of properly differentiating the responses of these patients. It does seem, however, that there is a very vague sense of sight in some of these blind eyes. These are manifested by a feeling that some patients have that they see a dark gray or even a colored pattern, which they attempt to describe, projected before either one or both of the enucleated eyes. It is difficult to determine whether they actually "see" these conditions,

though they may describe them as distinctly as the tinnitic patient describes his subjective sounds, or whether it has now become a visual hallucination, the patient thinking that he sees them. I have had a totally blind patient state that he seemed to "see in his field of vision" a boy on a bicycle that was constantly pedaling and yet never moved out of the range of his "visual field." It is obvious at once that it becomes exceedingly difficult to differentiate visual hallucinations from actual visual pathway irritation.

We certainly are not justified in classifying tinnitus as an hallucination, except in cases of well marked mental disturbances indicated by symptoms other than the fact that the patient hears noises; but is it unreasonable to suppose that in cases of tinnitus with complete deafness we have a certain amount of intellectualizing, as suggested by Schule? A survey of the literature leads to the conclusion that the persistence of subjective vision following the destruction of the optic nerve can hardly be compared to the persistence of tinnitus when we have every reason to believe all possibility of hearing is gone. While we were unable to find any definitely detailed report of patients who sometimes sense visual objects in spite of destroyed optic nerves, we all know that a case of persistent tinnitus, regardless of whether or not there is hearing, is a common occurrence.

Unfortunately, much the same situation prevails when we investigate the other special senses. Greenwood states that the senses of taste and smell have many points of resemblance, one of them being the scantiness regarding the physiology of either. In fact, we are unable to learn whether the gustatory cells are really end organs, such as the retinal cones or rods, or whether they merely act as props on which the nerve ends twine. Likewise, we have no knowledge as to the cortical representation of taste, although there is some trifling evidence that the anterior Sylvian convolution might possibly be its location. The cortical representation of smell is also doubtful, and the connections of the olfactory tract are numerous and complicated, while experimental work on lower animals is beset with numerous obstacles. Some of these animal experiments almost lead us to believe that smell, at any rate, does not depend upon the olfactory nerve. Magendus' experiment,

where the olfactory nerves in a dog were destroyed as far as the lamina cribrosa, indicated that the dog immediately on recovering from the operation was presented with several paper parcels of the same size, some containing cheese and others wood. The dog, without hesitation, selected and unwrapped the packages of cheese.

We have all had patients who complained of a "metallic taste" where metal could not be a factor, the so-called "dark brown taste" of the alcoholic, and numerous other apparent perversions of taste. However, we assume that there are physiologic if not pathologic explanations of these tastes, owing to the efforts of the system to throw off alcohol in the latter, whereas the patient with a metallic taste may have constipation or some other gastrointestinal tract disturbances accountable for the metallic like taste. However, it is possible that the metallic taste or some of the other tastes less frequently defined may be due to the same cause as tinnitus, though, of course, we have no means of proving this.

Again we have taken up the consideration of cutaneous reactions only to find that here we have no analogy between tinnitus and such conditions as cutaneous irritations, except possibly in such conditions as formication—that feeling of insects, such as ants, persistently running over certain areas of the skin. We had one case of this that persisted for years in spite of every conceivable treatment. It involved the supra-orbital branch of the right side. This was in a very active and well known patient, annoying him to such an extent that he almost had to give up his business. The symptom was entirely subjective, as there was absolutely no indication from the appearance of the skin that there was any pathology; although, as the patient is still living, it is impossible to state that there might not be actual neuritis or other pathologic findings in this division of the fifth nerve. At any rate, the evidence is sufficient to suggest an analogy here, but certainly a suggestion is the most that we can obtain, as in this case, too, we have no definite knowledge.

Consequently, after reviewing all of these subjects, we have not developed much constructive information. Generally speaking, we feel that there are definite though perhaps meager analogies, but we cannot make absolute deductions from

them. We feel that there is an analogy between the so-called "seeing stars" and "hearing a big rush of noise," as frequently described by patients subjected to head trauma. We might note here, too, that it is easier to believe drug tinnitus, as associated with quinin and other drugs, affects the center of hearing rather than the nerve tract, when we bear in mind that in quinin amblyopia the fundi may appear absolutely normal. In spite of our humble investigations, we feel more or less discouraged in finding definite data on which we may base conclusive results. We merely conclude that while tinnitus may be due to one cause, it most probably has multiple causes, eventuating in this one annoying symptom, which is so often accompanied with diminished hearing.

Three Cases of Lateral Sinus Thrombosis.*

By HERBERT B. WOODARD, M. D.

Wilmer H., boy of eight years, of rather frail physique, entered the hospital June 9, 1924. In March of this year a rash appeared, followed by some peeling, but which was not considered scarlet fever. The preceding summer he had sustained a fall on the pavement, striking the back of his head. There was no loss of consciousness, but nausea and vomiting followed, with a rather persistent headache lasting for weeks. About ten days before his entrance into the hospital he was politizerized for a catarrhal deafness of two weeks' duration. The following day he had pain in the right ear and a paracentesis was done the same day by the family physician with relief. The next day the left ear became painful and was opened. He apparently was comfortable until the day he entered the hospital, when his temperature went to 104 degrees. Both ears were discharging moderately, with no tenderness over either mastoid. Roentgen ray report: "Little departure from normal in either mastoid, but cells in left were cloudier, and septa of those close to antrum were partly obliterated." The white blood count on admission was 29,000. Both drum membranes were incised on June 12, to induce better drainage. For five days following admission the temperature ranged from normal to 103.5° each 24 hours, with slight chill preceding the

*Abstract of entrance thesis.

high temperature and perspiration following. Blood cultures taken June 13th and 23rd were negative. Left mastoid was operated upon June 15th, at which time both middle ears were discharging, with no tenderness that could be elicited over either mastoid. The cells were only moderately involved, and very little free pus or necrotic tissue was present. Diseased bone was removed from over the lateral sinus, and its wall was rough and thick and dull red. The internal jugular vein was exposed and severed between two ligatures. The sinus was then incised between tampons and found to bleed from the torcular end only. The temperature abated for two days, but on the third day it went up to 104° and on the two following days reached 103.5° with chills. Blood count at this time was 20,000. A combination of iron citrate and arsenic was used intravenously. Urotropin was given to the point of tolerance. Eleven days after the operation the temperature again reached 105° , with chills. For two weeks he had had some pain and tenderness in the left leg medially to the tibia, which now developed into an abscess and was incised June 30th. A chill and temperature of 103° plus on July 3rd was the last appearance of a high temperature. White cell count at this time was 25,000 and red cell count 3,000,000. From July 8th on, the temperature was normal or subnormal, and he left the hospital on July 14th with both ears dry, mastoid and leg wounds healed, and hearing about normal. The neck wound healed without suppuration.

Carl H., aged 6 years, developed a mild case of scarlet fever, undiagnosed, on November 23, 1924. The patient was about the house during the time with skin peeling freely later. December 19th pain began in left ear, the membrane of which was opened the following day. The discharge was free and blood tinged, and pain was only partly relieved. On January 3rd the tissues behind the ear were swollen, and the auricle was prominent, remaining in this condition until his entrance into the hospital on January 15th. The white cell count was 19,000 and the red 3,700,000. At this time examination of the throat showed very large tonsils without inflammation and a moderate enlargement of adenoid tissue. A reddened fluctuating swelling was present behind the left ear, with auricle standing out from the head. A fair amount of discharge was coming from

the middle ear. He was operated upon the same day through a Whiting incision and pus was found outside the periosteum. A fistula led to the antrum, and practically all of the mastoid cells contained pus and granulation tissue, with septa largely broken down. A very large tip cell was also infected. A large mass of granulation tissue covered the lateral sinus and this was not disturbed. The wound was packed as usual, and no sutures taken. The ear drum was incised and narrow gauze drainage left in the canal. Culture taken during operation showed streptococcus nonhemolyticus. Temperature at time of operation was 103.1°. Two days later, the 17th, the temperature ranged from 102 to 104.5 degrees, with nervous twitching and some cold sensations. Two days later the temperature ranged from 97 to 104 degrees in six hours' time, with considerable sweating but no marked chills. On January 20th, five days after the operation, the internal jugular was cut between two ligatures, the packing removed from the mastoid wound and the sinus examined. The mass over the sinus was incised for a distance of one inch between tampons. The tissue was rough and fibrous, and the sinus seemed a part of it to the extent that no free bleeding occurred from either direction when its wall was opened. It was left this way without probing, and iodoform gauze was used. A specimen of this dense tissue involving the sinus was examined by the Chicago Laboratory and a report returned characterizing it as a fibroblastoma. For three days after the operation the temperature ran a very sharp course, ranging each day from 98 to 105 degrees. From this time on it gradually improved, although ten days later it reached 103.5 degrees. This was the last high temperature, and the boy left the hospital on February 8th convalescent.

Gertrude B., aged 9 years, gave a history of an abscess appearing in the left ear two years ago. For the last ten days she has had a discharge from the left ear, which ruptured without previous pain. During the ten days she felt well but was kept from school. She had had no sickness for two years and was apparently a healthy child. Two days before entering the hospital she had a sudden rise in temperature to 104° with chills but no pain. The next day the temperature went to 105° plus and two or three chills during the day. She was

first seen when she entered the hospital on June 2, 1924, with a temperature of 105.6° and a chill of two hours' duration. She had a very tender left mastoid with some swelling of the tissues over the bone. She was very irritable, but bright mentally and had no pain when quiet. The mastoid was opened the same day, and the cells found to be extensively involved and filled with necrotic tissue and pus. Culture from the antrum showed streptococcus. The lateral sinus was bared for about one inch and opened, as it was covered by diseased bone and its wall did not appear normal. Bleeding seemed free from each end, and it was packed without ligating the jugular. There was considerable loss of blood from the sinus. She was returned to bed in one and a quarter hours, in fair condition, with proctoclysis. In twelve hours she became delirious and remained so for thirty-six hours, but with no high temperature. The blood count at time of operation was 10,000 white cells and 3,600,000 red cells. The urine was normal. Two days after the operation she began running a septic temperature, reaching 105.9° and dropping to nearly normal. Chills accompanied the rise and involuntary urination. Three days after the operation the jugular was ligated, as it seemed that a mural thrombus may have existed. Blood culture, July 7th, contained streptococcus and staphylococcus. Spinal fluid contained 12 cells to the cm., with no growth. The temperature gradually grew better, and for eleven days before she left the hospital it had not exceeded 102° , and occasionally she had a normal morning temperature. She went home July 25th with a white cell count of 20,000 and a red cell count of 3,500,000. She had had two blood transfusions early in July. Iron citrate and arsenic compound was given intravenously over a long period. She slept well during the latter two weeks in the hospital. It was thought that the child would recover, because at home she continued to be wheeled out of doors and had good nursing. On August 15th she returned to the hospital with an abscess in the right hip, which was opened and drained. The mastoid wound discharged for ten weeks from the time of operation. In October pus began to show in the urine with a large amount of sediment. As the condition grew worse, a diagnosis of suppurative pyelitis or pyelonephritis was made by Dr. Gardiner, who was attending her. There was

marked tenderness and rigidity over the right kidney area. She was readmitted to the hospital on November 5th for exploratory incision over the right kidney by Dr. Dyas, but no gross pathology was found. A third transfusion of blood was made at this time. Urine contained $4\frac{3}{4}$ per cent albumin and a large amount of pus. The red cells were 2,000,000 and the white cells 16,400. Gastrointestinal irritation with much distension, tenderness and pain developed, the incision over the kidney did not close, and the mastoid wound reopened. She died early in January, about eight months after the operation.

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